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from 10 years

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FROM SHAMELESS PROVOCATION TO RUMINANT IDENTITY CRISES, WITHOUT BEING PRECIOUS

This issue of POPULAR MECHANICS marks our 10th anniversary in South Africa and the start of a new decade as this country's leading science and technology brand. We've come a long way since our launch in August 2002, progressing from a single platform (print) to a demanding, multi-channel entity encompassing Web, e-mail newsletters, mobile interactions, social media initiatives, reader events, shows, conferences, brand extensions, television appearances, and more. Since a hefty slice of 21st century tech is focused on easier and more efficient communication, we'd like to think that we're keeping pace – and in some instances, staying ahead of the game.

PM is a unique magazine for a number of reasons. Although we acknowledge its nominal categorisation as a "male interest" title, we derive great satisfaction from its growing – and refreshingly spirited – female readership, pointing out whenever possible that very little of our content is gender-specific. (Yes, and we're including the cars, the gadgets and the DIY stuff.) PM is also special in that it covers everything from breaking science news to the latest consumer technology, from outdoor adventures to home improvement projects, from desirable cars and bikes to deeply philosophical questions that occasionally provoke discussions deep into the night.

We attempt to deliver all of this with the appropriate degree of gravitas (after all, our audience is known to be highly intelligent), but without being precious about it. Above all, we seek to surprise, delight and perhaps even provoke our audience with every issue. Take this one, for example: in an article titled "Incognito", we extract some thought-provoking ideas from the eponymous book by neuroscientist David Eagleman, a researcher who's clearly not afraid to make bold statements about our brains and how they sometimes trick us.

In macho mode, we embed ourselves – albeit briefly, with minimal chance of collateral damage – with some extremely tough American soldiers, gaining a rare insight into their training, thought processes and weaponry (see "Looking downrange"). In less combative mode, we preview the imminent touchdown of Nasa's one-ton rover, *Curiosity*, on the surface of Mars, then venture even further afield with a comprehensive account of our Sun's cycles.

We have more great gadgets and computers, of course, but we also offer sublime views of Earth from space, a distinctly sour view of Facebook, a showcase of bizarrely beautiful DIY guitars, and a profoundly moving account of an electric sheep that lost its identity.

Go on, be the first to know.

Page 20

Page 106

aland@ramsaymedia.co.za

We have always participated quite happily in events best described as "off the wall", as evidenced by this scene from the inaugural Red Bull Box Cart Race in Johannesburg. Our car, dubbed Popularsaurus, was an excellent machine; our pre-race performance – involving a plastic whip, a personal vibrator and a dozen red-dyed feathers (don't ask) – was appalling.

Our first cover, from August 2002, featured the new Southern African Large Telescope (SALT) near Sutherland (see the birthday section for an article about some of our most memorable covers). We launched the South African edition in the same year that our US parent celebrated its centenary.

COMPETITION WINNERS... Details online at *www.popularmechanics.co.za*

10th BIRTHDAY

Popular Mechanics

BE THE FIRST TO KNOW

CONTENTS

AUGUST 2012 VOLUME 11, NO. 1

On the cover: Bringing Special Operations forces to our cover shoot proved a little troublesome, so we improvised. To help model Tim Ryan portray one of America's elite soldiers, we armed him with an M4 carbine outfitted with a SOPMOD accessory kit. Photographer Monte Isom nailed the shot. This page: Best-dressed astronaut? Meet Nasa's Z-1 prototype space suit.

futuretech2012

Reserve your seat now for **PM's FutureTech** conference in Johannesburg on 25 October. For details, see page 87.

ALSO... Submit your entry soon and stand a chance of becoming South Africa's **Inventor of the Year** (big cash prizes are up for grabs in two categories). For details, see page 105.

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See page 84

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FOR OUR CURRENT SUBSCRIPTION RATES, SEE PAGE 50

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Winning letter

WHOSE BUSINESS IS IT, ANYWAY?

Your article on "rules of engagement" for Facebook users ("Social media faux pas", June issue) resonated with me because I had just discussed that very subject with my teenage daughter. It might be a generation thing, I told her, but for the life of me, I could not understand how people could post the most intimate details of their lives for all the world to see.

Our conversation was prompted by my daughter's revelation that her friend had confessed on her Facebook page that she was feeling depressed and suicidal. I found this both sad and alarming, but when I said so, my daughter told me not to worry because lots of people had responded to the post with expressions of sympathy. "You see," she said triumphantly, "Facebook can help people."

Me: *How many "friends" does she have*?

Daughter: *Oh, about two hundred.*

Me: *So if each of these people told two others, then at least 600 people know that your friend is feeling depressed and suicidal, right?*

Daughter: *What's your point?*

Here's my point: as you made clear in your article, once it's out there, it's out there. Fair or not, it's not impossible that in a few years' time, a potential employer could pick up a snippet on the Web about a certain troubled teenager, and think "Oh-oh, this one's a bit risky..."

NAME WITHHELD
CAPE TOWN

Editor's note: Of course social media users need to exercise caution; it's a no-brainer. Facebook is potentially dangerous and addictive, sure, but it's also useful, rewarding and remarkably versatile. At PM, we use it every day to good effect, and when we need a quick response from our connected audience, there's nothing quite like it. However, although the phenomenon has netted a good proportion of the planet's population, it's not for everyone: see this month's story by a critic who has opted out.

Write to us, engage us in debate, and you could win a cool prize; this month's best letter wins a desirable CAT watch worth R1 995. CAT Timekeeping Equipment reinvents and contextualises the heritage and authenticity of the brand's core know-how – clean and urban, encased in finely engineered stainless steel, and equipped with a technically advanced movement. For more information, contact S Bacher & Co on 011-372 6000 or visit *www.sbacher.co.za*

Send your letter to: Popular Mechanics, PO Box 180, Howard Place 7450 or e-mail *popularmechanics@ramsaymedia.co.za* Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.

Let's skip the traditions

Your detailed analysis of the *Costa Concordia* disaster ("What went wrong", June issue) was fascinating. What I found utterly amazing and disturbing was the decision of the captain – the person responsible for the safety of over 4 000 passengers and crew – to deviate from his course and steer the huge ship dangerously close to the island simply because it was a tradition "to salute a beloved former captain". Are there any other maritime traditions that we should know about before we book our next cruise?

N TAYLOR
CENTURION

How to rebuild the human

I had a discussion with my son yesterday about an article I recall reading in Popular Mechanics years ago in which you listed ways in which the human body could have evolved to achieve better efficiency – think back-to-front retina, the pharynx, the awkward and painful birth process, and so on. My son was especially interested in the last one, and he came up with an astoundingly good question: why aren't we born with narrow shoulders and cone-shaped heads? For the record, he also thinks human children are wimps because they are utterly helpless for the first few years of their lives.

PETER GRAY
CAPE TOWN

Save us from conspiracy theorists

I wish Popular Mechanics would find out whether anyone has conducted research on why some people become conspiracy theorists. I have two relatives who regularly subject me to bizarre theories on everything from crop circles to Moon landings (you know, how the Americans faked them), and it's driving me to the point where I am becoming quite rude. Any advice? Perhaps the name of an affordable psychoanalyst?

TONY LATEGAN
EAST LONDON

*Editor's note: We feel for you. According to a recent study by researchers Michael Wood, Karen Douglas and Robbie Sutton at the University of Kent, the viewpoints of these people can be so strong that "it leads to inconsistencies, muddled thinking and belief in the impossible". That's putting it mildly. Prepare yourself for the next onslaught with Wikipedia's mildly disturbing list of conspiracy theories (*bit.ly/XsCtl*).*

Pictures tell the story

I always enjoy your back page hints, and have used many of them in my home and garden over the years. The winning tip in your June issue, about creating a vertical garden in a small courtyard, inspired me to build something similar for our townhouse. Just one niggle, though: we could have done with a photograph of your tipster's project to keep us on the right track.

FRANS LOUW
PANORAMA

Editor's note: We asked for one but no picture had arrived by the time we went to press. Perhaps you could oblige when your garden is up and running.

Shocking revelations dept

I am something of an auction junkie and have attended some memorable sales all over the world, including the United States. About three years ago, on a visit to California, I stumbled upon an auction in which someone bought a real electric chair for a couple of thousand dollars. Has our planet indeed been invaded by aliens?

LIONEL NELSON
VIA E-MAIL

Editor's note: Yes. We've been in their thrall since the 1950s. As for electric chair auctions, you may be interested to learn that the world's most (in)famous chair, nicknamed "Old Sparky", attracted a high bid of $29 000 when it was offered for sale on eBay some years ago (it was later withdrawn after questions were raised about its ownership). In fact, electric chairs in several US states were given the same nickname.

Still in front, thanks to PM

Visiting a flea market a while ago, I found a copy of a POPULAR MECHANICS title, *Electronics Made Easy – A Build-It-Yourself Book*, dating back to 1956. Chapter 6 is headed "Transistors" and includes the alarming statement that "(this) tiny device... is threatening the position of the vacuum tube as the basis of all electronics". It goes on to predict that transistors are destined to play a tremendous role in the future of electronics. Little did they know!

As a constructional guide it is, of course, of little use: most if not all of the valve and transistors specified are long since unavailable, and few of today's electronics fans have the metalworking skills needed to cut, bend, drill and punch the chassis or work with 350-volt HT wiring. But as a look back, showing just how far we've come over half a century, it's fascinating. From single point-contact germanium transistors as "tiny" as a pencil eraser, we've moved on to multi-billion-transistor integrated circuits the size of an aspirin.

History *can* be interesting. And this cheerful, 56-year-old gem of a book gives an idea of how long PM has been with us at the forefront of technology.

CHRIS GRAHAM
RANDBURG

What about the ecosystem?

The letter by Johannes Bertus de Villiers ("Let's bring them back", June issue) refers. I understand the writer's point of view; however, I am taken aback by his mention of "undoing" mankind's mistakes, as i fear this may imply not only the cloning of the woolly mammoth, but also the reintegration of the species into our ecosystem – an ecosystem that is already hard-pressed to support its current fauna.

The woolly mammoth's end – as with the end of all the species of that era – is what allowed our current ecosystem to come into being. This animal does not belong in it. Also, the "re-starting" of any species will inevitably lead to the "re-starting" of others. The woolly mammoth ate certain plants, some of which may no longer exist. Do we need to recreate these, and a mini-ecosystem, just to support this creature? I'm not saying this is morally wrong; merely that now is not the right time.

GIDEON ROOS
VIA E-MAIL

Taking a break from tech

Thank you for a most thought-provoking article on why some people are taking a break from the barrage of technologies that is overwhelming our world ("I just can't quit you, technology", June issue). Probably the most telling quote comes from Harley Hahn, who points out that while technology continually seduces us, we don't really understand what is happening: "This is why so many people keep phoning, text messaging, instant messaging and e-mailing one another without ever feeling satisfied enough to stop..."

I absolutely agree with Linda Stone, who says the tech onslaught has kicked us into a state of "continuous partial attention", allowing us to keep tabs on everything without truly focusing on anything. Although PM obviously espouses the cause of advanced technology, it's good to see that your magazine hasn't lost sight of the implications for the hapless end user!

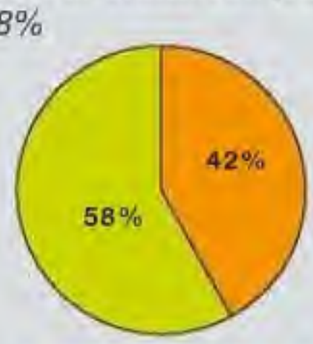
L CROMBIE
PORT ELIZABETH

PM

MONTHLY POLL

Cloud computing is set to boom, transforming the way small SA businesses consume ICT services. Is your head in the cloud?

- *Yes. It's cost-effective, and adds improved operating functionality and flexibility. Plus, your office is wherever you are. 42%*
- *No. I'm worried about security and I'd prefer to know exactly where my data is being stored. Cloud computing is not for me. 58%*



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1962 One of our cover stories for this issue focused on industrial espionage, describing the work of private eyes on company payrolls who used rapid-sequence cameras, ultra-sensitive microphones and even disguises to penetrate the lairs of their client's competitors. We interviewed one spy who travelled 160 000 km a year on undercover information-gathering expeditions.

1943 We recently bragged in an interview that we felt no need to attract readers by publishing pictures of women in bikinis. (Er, then again...) Since we are unable to access sales statistics for our US edition, we cannot say for certain that its newsstand numbers plummeted as a result of this lapse of judgement.

1936 In case you were wondering, vehicle hijacks are by no means a modern phenomenon. All of 76 years ago, we featured this nifty idea for foiling a hold-up man's attempt to mount a truck's running board: he would simply slide off the sloping wooden block and, one presumes, land in the gutter. Of course, this made it a little harder for the driver to get in and out of the cab.

1929 Eighty-four years ago, we published these pictures of two cheats, both involving shameless young women. The first was a 19-year-old female stunt driver who performed somersaults in her car with the help of a rocking chair-like frame (a man would have scorned the frame, and probably killed himself); the second was a girl who played a harmonica tricked out with a tiny music roll and hand crank. **PM**

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1. PORT Astronauts step into the full suit through the back port. This port will mate with the spacecraft, enabling an astronaut to enter the suit from inside the craft for extravehicular activity. Another advantage: when used in low to no atmosphere, the port conserves more air than a conventional air lock.

2. MOBILITY The Z-1 has bearings at the waist, hips, upper legs and ankles to allow an astronaut greater mobility – essential for retrieving soil and rock samples in tough terrain.

3. MATERIAL This provisional outer covering conceals a heavily engineered inner suit; a layer of urethane-coated nylon retains air, and a polyester layer allows the suit to hold its shape.

SPACE TRAVEL

Bespoke suit

Nasa may not know whether its next destination is an asteroid, Mars or the Moon, but the agency is definitely planning for some kind of journey – and its engineers need to figure out what to pack. "It's like you're trying to go on vacation, but you don't know if you're going to Antarctica, Miami or Buckingham Palace," says Amy Ross, a spacesuit engineer at Johnson Space Centre. The Z-1 prototype – currently being tested in a vacuum chamber – has been designed for versatility: to explore alien surfaces, float outside a space station, and even weather the radiation of deep space. "We're building a lot of tools for the toolbox," Ross says. "Right now, we're asked to be very flexible." – *MARY BETH GRIGGS*

AMY ROSS, ENGINEER ▲

Pictures by Brent Humphreys

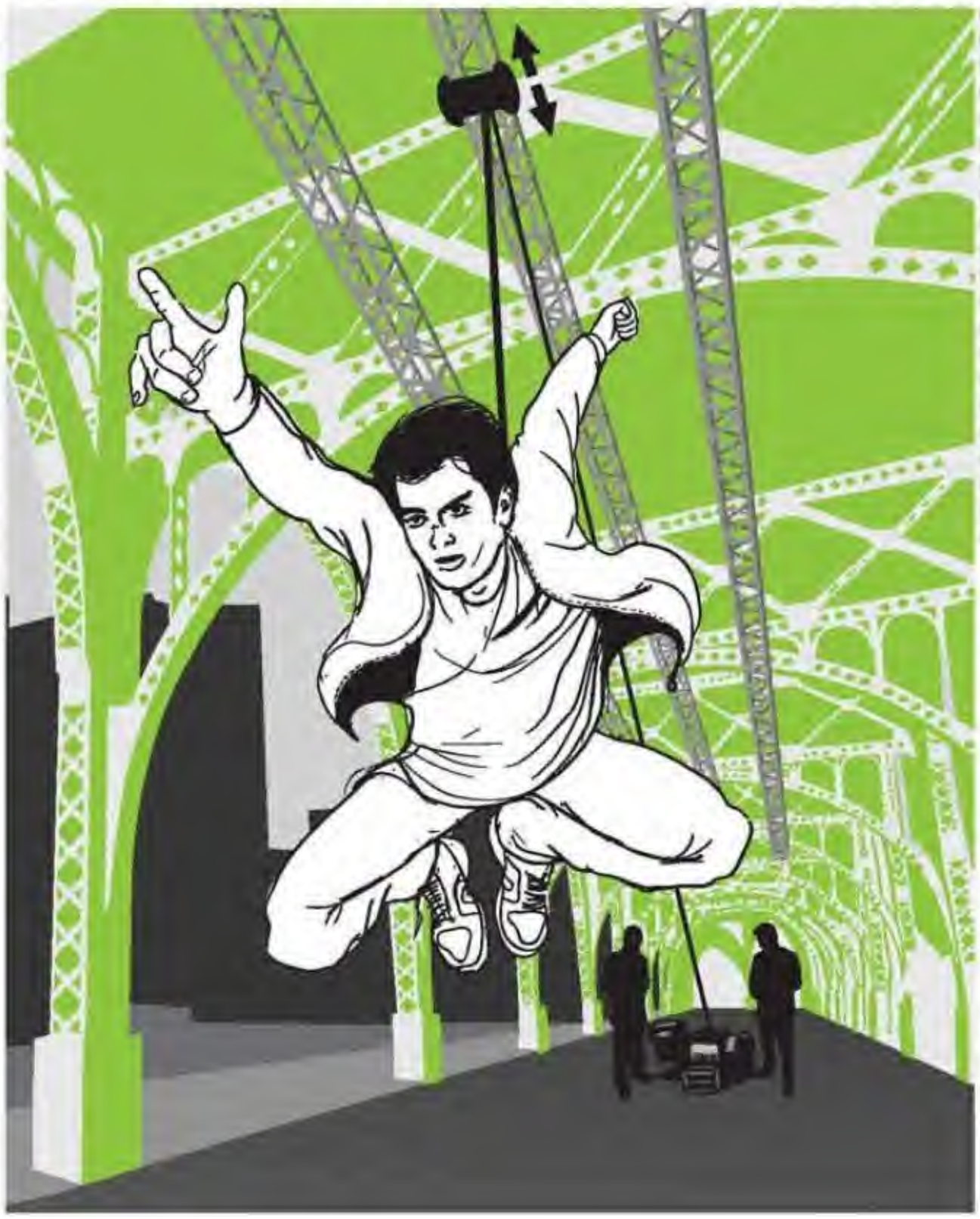


Illustration by RAID71

HOW IT WORKS

- To begin swinging, an actor jumps off a crane wearing a harness that's wired to a pulley, in turn attached to an electronic winch.
- As he reaches the bottom – travelling at 64 km/h and pulling 3 g's – and begins to arc upward, an operator moves the pulley forward 15 metres. "It's like cracking a whip, where it goes along, stops, goes along, stops," says stunt co-ordinator Andy Armstrong. "We did that two or three times." The wires were erased in post-production.

TECH CULTURE

Full swing

Spider-Man would be nothing without his swing. To create the character's signature web slinging in *The Amazing Spider-Man*, released in the US last month, stunt co-ordinator Andy Armstrong studied slow-motion footage of gymnasts, then built one-of-a-kind rigs to allow actor Andrew Garfield and the film's stuntmen to emulate their motion. The team used the aluminium-truss system in many locations: one track, built under a bridge in New York City, was 54 m long; another rig hung off an old fire truck to make it look as though Spider-Man was swinging through traffic. The system enabled director Marc Webb to get more realistic web slinging than ever before – a fact that delights Armstrong. "A lot of kids have grown up with video games and computer-generated characters," he says. "There's still something much more exciting about seeing a real human do something that we'd all love to do if we had the ability." – *ERIN MCCARTHY*

A MARCH 2012 SURVEY found that 11 per cent of Americans have seen a TV weather forecaster mention global warming five or more times in the past 12 months; 58 per cent would like to hear a forecaster talk about it. And in South Africa? If it has nothing to do with spears or presidential ire, bring it on...

NEWS BRIEF *Weird life*

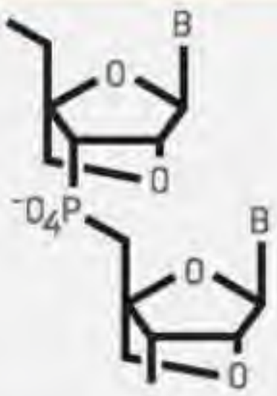
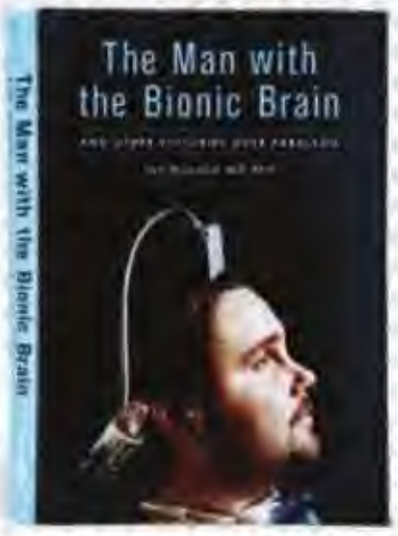


Diagram by Martin Laksman (XNA molecule)

Every living thing on earth uses DNA or RNA to carry its instructions for life. These two nucleic acids are built from different sugars: DNA from deoxyribose and RNA from ribose. Now scientists have shown that at least six other types of sugars can form nucleic acid backbones – and they can be used to store and retrieve genetic information. Called XNAs (for xeno-nucleic acids), the new synthetic chains could address important questions about the origin of life. John Chaput, a team member and molecular biologist at Arizona State University, poses an even more tantalising one. "Could you create synthetic life with it?" he asks. "That's possible, but it's much further down the road." – *SARAH FECHT*

60-second genius



Jon Mukand, MD, author and principal investigator for BrainGate

Q. How is the human brain like a computer?

One major similarity is that both the brain and the computer have intricate circuitry; but the brain has many, many more connections because it contains 100 billion neurons.

The other similarity – and we used this in research for the BrainGate – is the logical processing of information that occurs in both the brain and the computer. We placed an array of 100 electrodes, each thinner than a hair, in a paralysed patient's brain, at the area that controls the hand. Then we recorded nerve signals from this array while asking the patient to imagine moving a computer cursor.

The BrainGate software correlated specific patterns of nerve activity with specific intentions of the patient, and stored this information. (Brains and computers both have memories.) When the patient wanted to move the cursor, the software figured out that X pattern of nerve activity meant the patient wanted to perform Y task: to check e-mails, control a TV or even move a robotic hand. – *As told to DALENE ROVENSTINE*

SPACE ENTREPRENEURS

Rock on

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18 %

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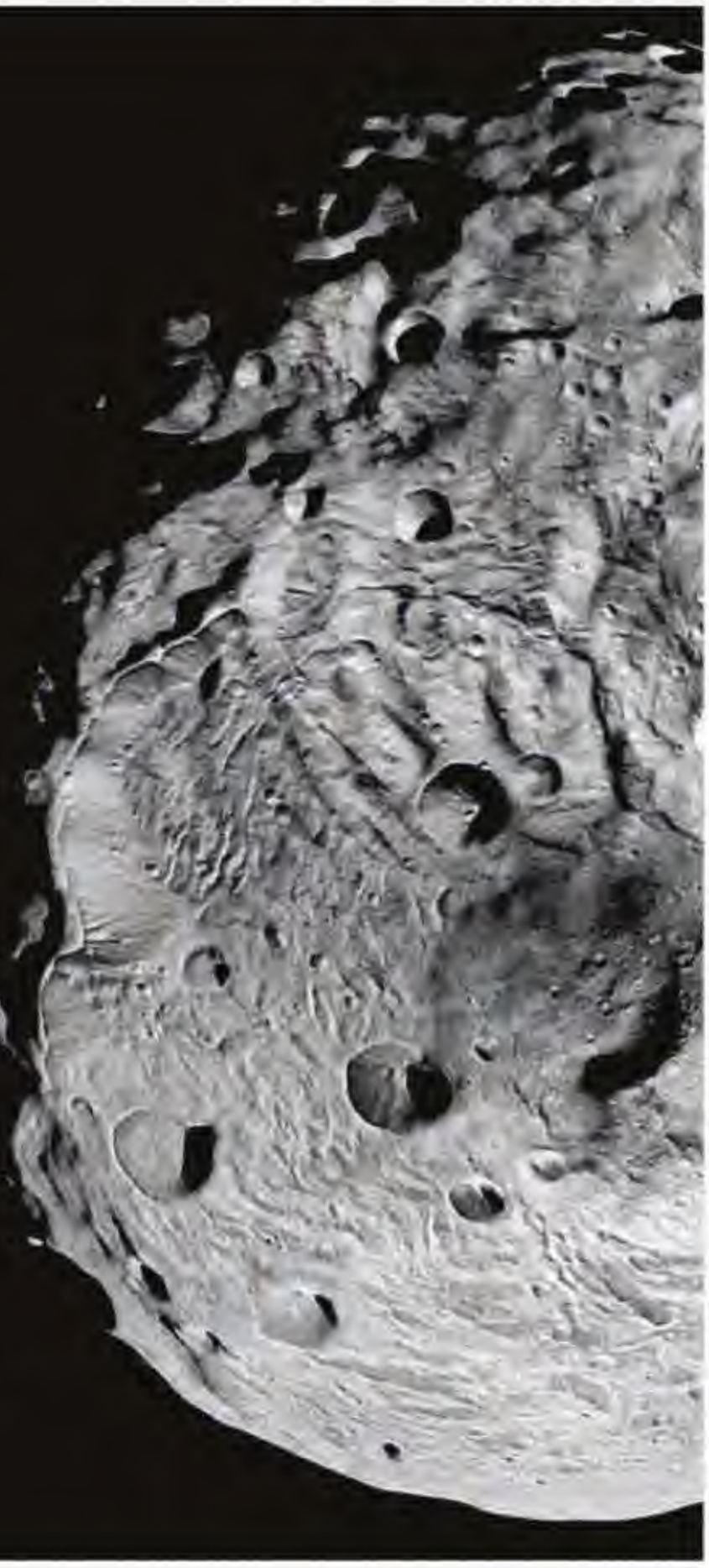


Illustrations by Martin Laksman (telescope), AMANDA LANZONE (Popmech man)

Forget exploration. Forget tourism. Following the money, the next big development for space may be exploiting its resources. In April, a group of billionaire investors, space experts, and former Nasa engineers announced ambitious plans to mine asteroids. Their company, Planetary Resources, is already constructing a telescope, which it expects to launch within two years, to prospect likely targets. Swarms of cheap robotic craft built on an assembly line would be deployed later to do the mining – water and ordinary metals would be used in space, while precious metals would return to Earth.

"Landing spacecraft on another planet is one of the most exciting and rewarding things you can ever do," Planetary Resources' president and chief engineer (and former JPL Mars mission manager) Chris Lewicki says. "But when you have an opportunity like we have to redefine how it can be done, that's really attractive." If the company succeeds, the payoff for investors such as Google's Larry Page and Eric Schmidt could be, well, astronomical. According to Peter Diamandis, CEO of the X Prize Foundation and a Planetary Resources co-founder: "A 500-metre asteroid of the [optimal] metal chondrite contains more… precious metals than have ever been mined in the history of humanity." That's awfully attractive, too. – *MICHAEL BELFIORE*

JUST CURIOUS

Core competency

PM TECH EDITOR GLENN DERENE NERDS IT UP WITH US SECRETARY OF ENERGY **STEVEN CHU** ABOUT THE WORLD'S FASTEST COMPUTERS.

Q Have you had any personal experience with supercomputers in your research career?

A When I was an undergraduate at the University of Rochester, I had a summer job where I programmed Control Data supercomputers. Later, when I was working at Stanford (University) and Berkeley (National Lab), I was on the board of directors for the graphics chip-maker Nvidia. Today, Nvidia's GPU chips are used in four of the top 10 supercomputers in the world.

Q **Today's fastest computers operate in petaflops (1 015 operations per second), and there's a national initiative to move towards exascale computing, which would increase processing speeds a thousandfold. How much computer do we really need?**

A When you're doing baby calculations – Excel calculations and graphing – your laptop is all you really need. For solving differential equations, the current generation of supercomputers is pretty good. But once you go into big-time simulations – climate or jet engine or fuel injection – for the next factor of 100 to maybe 1 000, you want more.

Q **What effect have supercomputers had on global competitiveness?**

A (Supercomputers are) directly related to a country's industrial sophistication. But it's deeper than being the biggest guy on the block. At the Department of Energy, we see supercomputing as being more and more of an industrial tool. The benefits filter down to everything from the aerodynamics of cars and trucks and airplanes to the efficiency of jet engines and high-performance buildings.

ANIMAL COMMUNICATION

Hot stuff

Using a realistic "robosquirrel" – a taxidermic ground squirrel with a mechatronic tail – a team of engineers from the University of California, Davis, and biologists from San Diego State University are studying the evolutionary arms race between squirrels and rattlesnakes. When the robosquirrel waves and heats its tail, mimicking the animal's behaviour, snakes in the wild back off. This confirms that adult squirrels use interspecies infrared communication, and that rattlesnakes rely on IR-sensitive pit organs more than their eyes. – *ALEX HUTCHINSON*

Illustration by Ryan Brinkerhoff

VIDEO > Visit *www.popularmechanics.co.za* to see how the robosquirrel wards off a rattlesnake, proving the theory that tail wagging discourages an attack.

Electro-harmonix

RETRO RULES

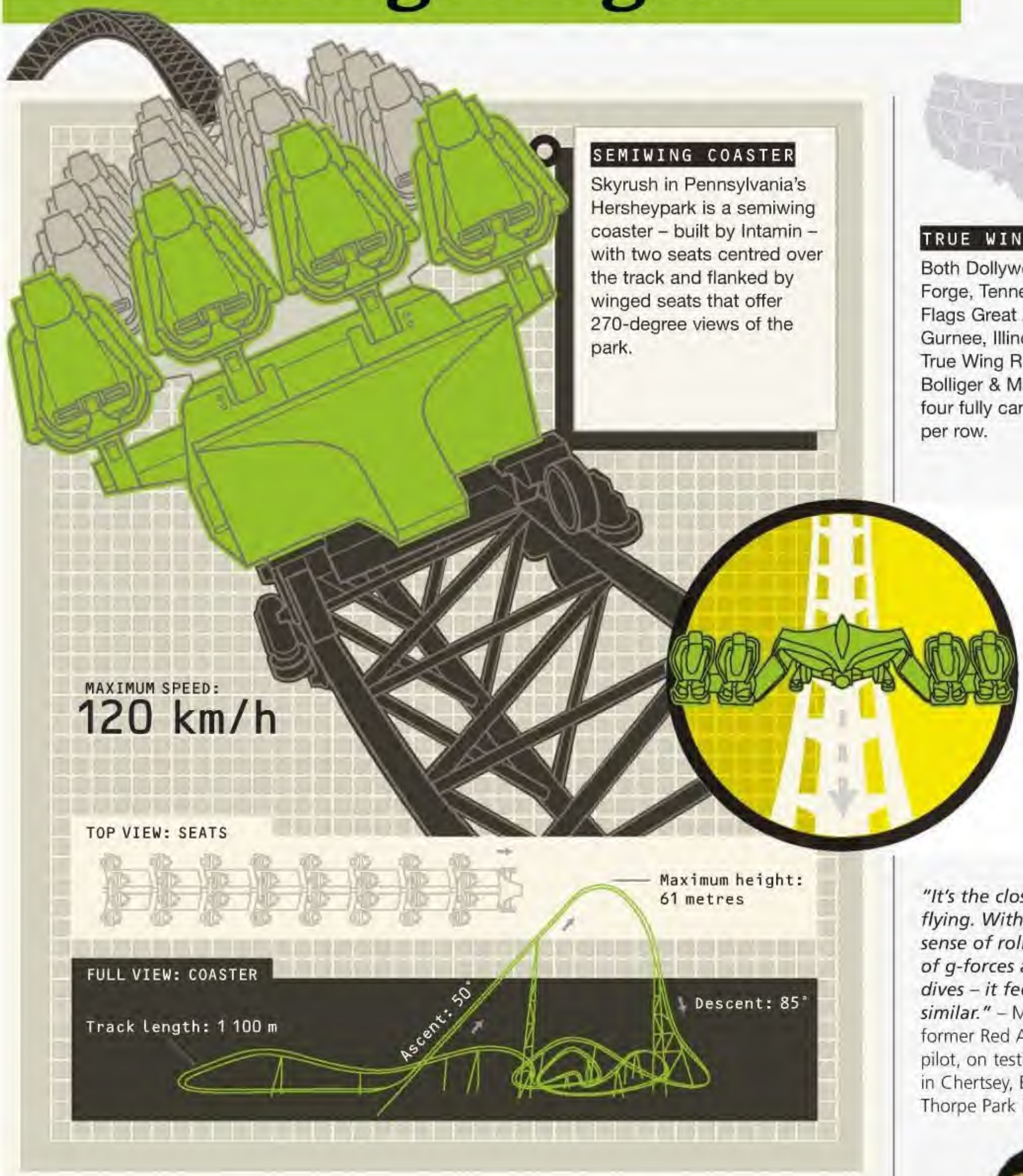
The invention of the transistor in 1947 relegated bulky, hot, power-hungry vacuum tubes (some call them thermionic valves) to the ranks of historical oddities. Now University of Pittsburgh researchers have proposed harnessing tube tech to create a new class of low-power, high-speed devices that could unblock what seems to be a traffic jam in the progress of Moore's Law (see below). Says principal investigator Professor Hong Koo Kim, electrons frequently collide or scatter in a solid-state medium. However, his team found that electrons trapped inside a semiconductor at the interface with an oxide or metal layer could be easily extracted using a low voltage and then routed through a nano-scale vacuum channel – without any collisions or scattering.

It's the Law

Moore's Law predicts a doubling of the number of transistors on integrated circuits every two years. But, as semiconductors shrink down to nano levels, Moore's Law is bumping up against physical limits – and efficiency is falling.

ADVENTURE

Riding shotgun



TRUE WING RIDER

Both Dollywood in Pigeon Forge, Tennessee, and Six Flags Great America in Gurnee, Illinois, opted for True Wing Riders – built by Bolliger & Mabillard – with four fully cantilevered seats per row.

"It's the closest thing to flying. With the smooth sense of rolling, pulling of g-forces and screaming dives – it feels very similar." – Mark Cutmore, former Red Arrows fighter pilot, on testing a wing rider in Chertsey, England's Thorpe Park in February.

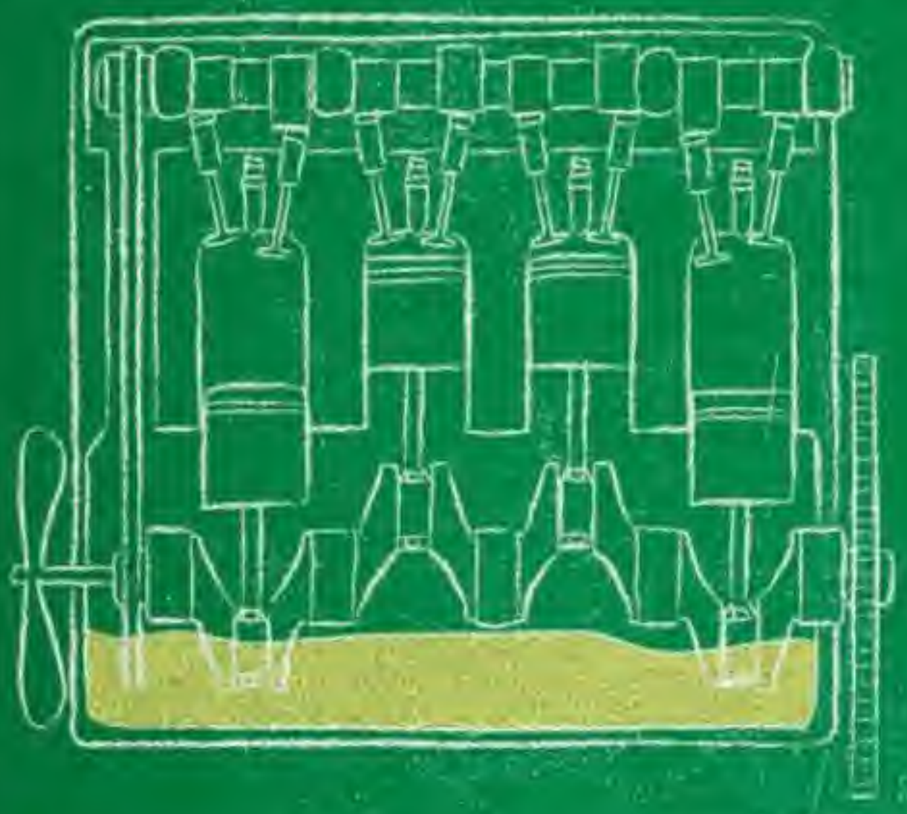
This year, three US amusement parks debuted a new breed of roller coaster – delighting adrenaline junkies and horrifying the friends they drag along. These wing coasters have cantilevered seats, which amplify their movement and better simulate the sensation of flight. Passengers experience up to 5 g's in three directions. Shifting people's weight from the centre of the track posed engineering challenges: loads on the floorless seats are nearly three times greater than on traditional ones, so Hersheypark chose to mill each 2-ton car frame for its Skyrush coaster from one large piece of steel. – *ALLISON MCCANN*

> Visit *www.popularmechanics.co.za* to catch the adrenaline-pumping Skyrush coaster in action.

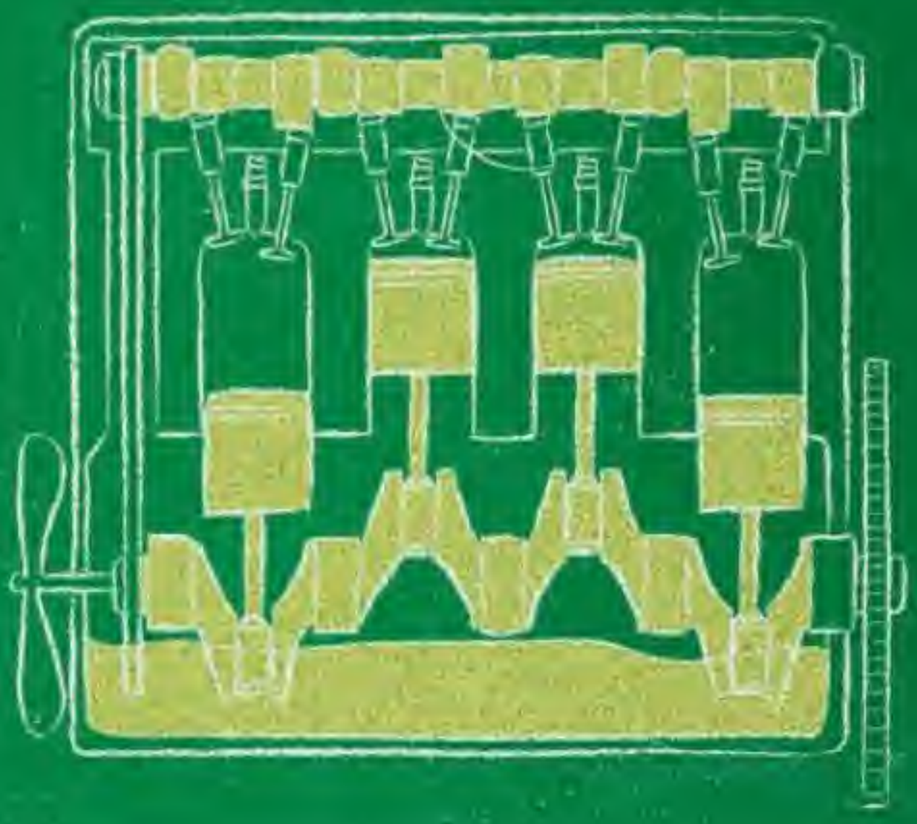
Illustration by Curtis Jinkins

HAS YOUR ENGINE GOT THAT SINKING FEELING?

Most engine oils sink down into the sump protecting only part of your engine at start-up.



Castrol Magnatec clings to your engine, so it is always protected.



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PROTECTION FROM THE MOMENT YOU TURN THE KEY

IT'S MORE THAN JUST OIL.
IT'S LIQUID ENGINEERING.

Castrol

NEWS BRIEF / *Viking mice*

When Norwegian Vikings sailed off to loot and pillage, they inadvertently took mice with them. By digging up the bones of ancient rodents and comparing their DNA to modern house mice, an international team of researchers is retracing the various phases of human migration across the Atlantic. Mice from 10th- to 12th-century settlements in Iceland and Greenland have the same DNA markers as the Viking stowaways. Today's mice in Iceland do, too, with very little genetic variation in the population (just like the island's human population). In Greenland, on the other hand, modern house mice aren't related to the Viking species – a more recent wave of immigration wiped them out. Similarly, there's no trace of Viking DNA in house mice living in Newfoundland, the furthest west the Vikings reached. – *AH*

Illustration by Ryan Brinkerhoff

ATMOSPHERIC SCIENCE

Government chemtrails (really!)

Usually, when strange cloud formations appear in the sky, anyone blaming government experiments can be easily dismissed as a paranoid crackpot. Not this time.

On 27 March, Nasa launched a volley of five rockets from its Wallops Flight Facility in Virginia. The rockets released a chemical tracer, called TMA, that produced milky clouds visible from the Deep South to the Canadian border. But the purpose of the experiment was less nefarious than mind control or behaviour modification: the agency wants to learn about the volatile high-altitude jet stream about 95 to 105 km above the ground.

Winds in the upper jet stream can exceed 480 km/h, and strong electrical turbulence there can disrupt radio and satellite communications. By studying how the tracer clouds drifted apart, along with pressure and temperature data from sensors onboard two of the rockets, researchers will be better able to model this region of Earth's atmosphere.

– *ALEX HUTCHINSON*

GLOSSARY

TMA Trimethylaluminum produces aluminium oxide, carbon dioxide and water vapour when it reacts with the air. Nasa has used TMA to study the near-space environment for decades. It can burn skin, but Nasa says the high-altitude release poses no threat. **PM**

VICTOR MATFIELD
SOUTH AFRICAN RUGBY PLAYER + FATHER

TOUGH OR CARING. WHY CHOOSE?

[48H. TOUGH ON SWEAT, NOT ON SKIN.]

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Looking downrange

/// You think you know special operations – teams of gunslingers who launch midnight raids against terrorist camps, blow up bridges, or call in covert airstrikes. But the traditional role of spec ops is training foreign soldiers and building stable nations, skills that will be put to the test as the US withdraws from Afghanistan. PM rides with an A-Team as it prepares to guard America's exit from its longest war.

BY JOE PAPPALARDO ///

PHOTOGRAPHS BY CHAD HUNT

PM spent a week with operators in Washington state as they prepared for deployment to the Middle East. Handling armoured trucks is one of dozens of skills they must learn.

46°45'40"N
120°11'29"W

LOOKING DOWNRANGE

Dawn is breaking as six members of the A-Team gather for physical training (PT) at an empty trailhead in Yakima, Washington. The men, dressed in MultiCam desert camouflage, deploy from a white government-issued van and immediately start unloading rucksacks and doing leg stretches.

Only half of the 12-man detachment, part of the 1st Special Forces Group, is available to stalk Rattlesnake Hills on the edge of the city for this morning's PT. One member is injured, another is in sniper training, and the team's Fox (intelligence specialist) is in dive school. The rest are sleeping off the prior night's guard duty at the Yakima Training Centre. The clandestine operational detachment is a long way from its home base at Okinawa. The wide, undulating landscape and relentlessly rocky terrain here more closely resemble Afghanistan, where the team is slated to spend 2013.

The men shrug on 13 kg rucksacks and wordlessly start the brisk march. Boots crunch on gravel in an increasing cadence. The detachment's Alpha (commander) is a 29-year-old captain, a combat veteran who served in the infamously violent Korengal Valley in Afghanistan while with the conventional Army. His Zulu (senior non-enlisted) is a 37-year-old master sergeant; this team has no warrant officer, so the Zulu is second in command. Since this A-Team is readying for a deployment – they call it going downrange – their real names cannot be used. Special operations forces (SOF) value secrecy above everything except physical fitness.

The team's leaders call out a word of warning: no running allowed. "If one starts, they'll all try to be first," Alpha says. "We all have Type-A personalities on this team." The trail winds steadily upward, past a handful of isolated ranch homes. As soon as the team sees an opportunity, the members leave the semi-paved road and ascend a steep hillside matted with rocks and ankle-high tangles of scrub brush.

The team's senior Echo (communications specialist) pauses to admire the view. He's a sergeant first class with 15 years of experience in the military, including work as a scout and sniper in the conventional army. His shoulders are broad and so is his grin. He smiles a lot. Yakima never looks better than it does from the crest of a hill at dawn, city lights still glittering under a recently risen sun. "Kinda makes getting up at oh-five-hundred worth it," he says.

A civilian four-wheel all-terrain vehicle is unexpectedly waiting for the team as it finishes zigzagging down the slope. The homeowner driving it quickly endorses the men's presence in a polite hearts-and-minds moment. "It's okay, if it's you guys," he says. "I have to come out and check on people, since methheads and hookers come up here to do their business sometimes."

It's considered a light morning of PT; a more typical start to the day consists of a 90-minute run (not including forward and backward sprints up the inclines and a slate of leg-

SPECIAL OPS' GLOBAL SCOPE

01 YEMEN

Direct action: Airstrikes

Objective: Hunt members of al-Qaeda in the Arabian Peninsula who are seizing towns and attacking government officials.

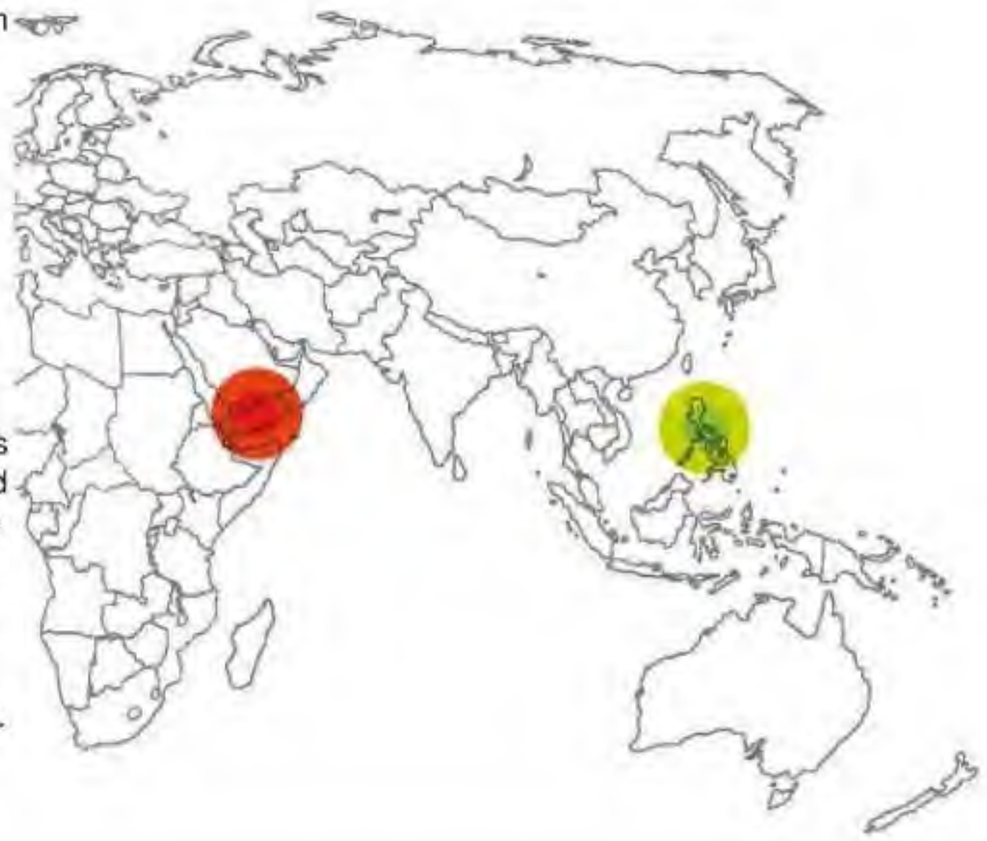
Update: Special Operations Command (SOCOM) and the CIA pick targets for drone and manned aircraft attacks against al-Qaeda leadership and clusters of fighters. The Web site Long War Journal estimates that 23 strikes have been carried out since December 2009.

02 PHILIPPINES

Indirect action: Foreign Internal Defence

Objective: SOCOM deployed to the island of Basilan to counter gains made by the Islamist insurgent group Abu Sayyaf.

Update: A 500-man spec ops task force trains local military units to take and hold ground from Abu Sayyaf. Since the mission's inception in 2002, 17 US service members have died while advising and assisting Filipino forces.



46° 45' 40" N
120° 11' 29" W

WAR WAGON: The US Army has more than 8 000 Mine-Resistant Ambush-Protected-All-Terrain-Vehicles (M-ATVs) for use in Afghanistan. Special operations forces received 460; Oshkosh modified the vehicle to suit SOF needs.

TRUNK MONKEY
The cargo area of a spec ops M-ATV can be accessed through a hatch in the cab. A mounted weapon covers the blind spot behind the vehicle. The cargo area can handle a variety of communications and other spec-ops-specific hardware.

CROWS' NEST
A common remotely operated weapon station (CROWS) sits on the top of all spec-ops-modified M-ATVs. The system accommodates a variety of machine guns that can be fired from inside the vehicle. A gunner can zoom in on targets with the day/night optics and fire using a joystick.

SITUATIONAL AWARENESS
Special Operations Command requested a larger windscreen so drivers would have better awareness of what's outside the vehicle.

Most of this A-Team has conventional army experience in Iraq or Afghanistan and has done spec ops counter-insurgency work in the Philippines and Iraq.

burning squat thrusts) and the first of two daily free-weight workouts. But the next few days and nights at the army training centre will be crammed with lessons in operating vehicles they have never driven before. A brief hike will have to do.

Alpha's men will be among the nearly 10 000 special operators in Afghanistan in 2013, preparing for the administration's 2014 exit of major combat troops. "While the aggregate number of total personnel in Afghanistan will decrease as we approach 2014, the special operations forces' contribution may increase," Admiral William McRaven, head of Special Operations Command (SOCOM), told the US Congress in March. They will be there until at least 2017.

The expectation in Washington, DC, is that these teams can take the lead in keeping the Afghan central government in control of a dysfunctional country of 35 million. If they can, America's longest war will end with a qualified win. If they fail, the nation could slip into civil strife and again become a haven for terrorists. "The rumbling around town is that special operations forces will basically own the US mission in Afghanistan," says Travis Sharp, a fellow at the Washington, DC-based Centre for a New American Security. "SOF has been on the rise for a decade. Now we are going to see if they can hold and consolidate gains." He adds: "If I trust anyone to get the job done, it'd be SOF."

Although Pentagon planners are finishing this war with a geopolitical Hail Mary pass, at least they are relying on the right players. Special operations A-Teams are made of incredible individuals with an action hero's résumé of skills: para-jumping, foreign-language fluency, a professional athlete's physical conditioning, and familiarity with an entire catalogue of vehicles and weapons. And then there are the specialties: construction and demolitions, communications, intelligence gathering, and battlefield medicine verging on internal surgery.

These dedicated, sincere men are setting out to tame a land of suicide bombing, systematic abuse of women, and legendary duplicity. They are high-value individuals deploying to a place where human life has little value.

During the ruck march, I remark to Zulu that my backpack weighs about 9 kg less than his. I recycle a line from a *Dirty Harry* movie to explain my minimalist packing: "A man's got to know his limitations." The 37-year-old Zulu shoots me a sceptical look. "Oh, really?" he says. It's clear I have spoken heresy. Admitting something can't be done is not in these guys' DNA.

SPEC OPS GEAR: WHAT THEY WANT

OFFICIALS AT SPECIAL OPERATIONS COMMAND IDENTIFIED WEAPONS TECHNOLOGIES THAT THEY WOULD LIKE TO FIELD IN UPCOMING YEARS. THEIR WISH LIST SHEDS LIGHT ON THE MISSIONS THAT OPERATORS CONDUCT.

01 DIY AIRSTRIKES

There are times in an operator's career when close air support or heavy artillery is not available and a target must be eliminated from a distance. In 2011, SOCOM asked industry for a missile system capable of striking enemy personnel, moving vehicles and light structures at a range of 15 km. The system's total weight is to be 29 kg – light enough for a team to carry in rucksacks.

02 NEW TOOLS FOR SNIPERS
Flatter trajectory rounds for 7,62 mm, .300 Win Mag, .338-calibre and .50-calibre sniper rifles will not only make the weapons more accurate, but will enable them to hit targets with more kinetic energy at extreme ranges. Another request is for a sniper rifle that can be broken down into a clandestine package.

03 NON-LETHAL GRENADES
SOCOM requested industry solicitations for a new kind of 40 mm low-velocity grenade that can dispense liquid or gas into a vehicle or vessel without harming the individuals inside.

04 BETTER MASKING FOR RIFLE SHOTS
SOCOM is seeking integrated suppressors for rifle barrels that can hide infrared and thermal signatures when the weapons fire – rendering them invisible to opponents' night-vision goggles. These devices need to work despite the weapon's recoil and changes in its barrel temperature.

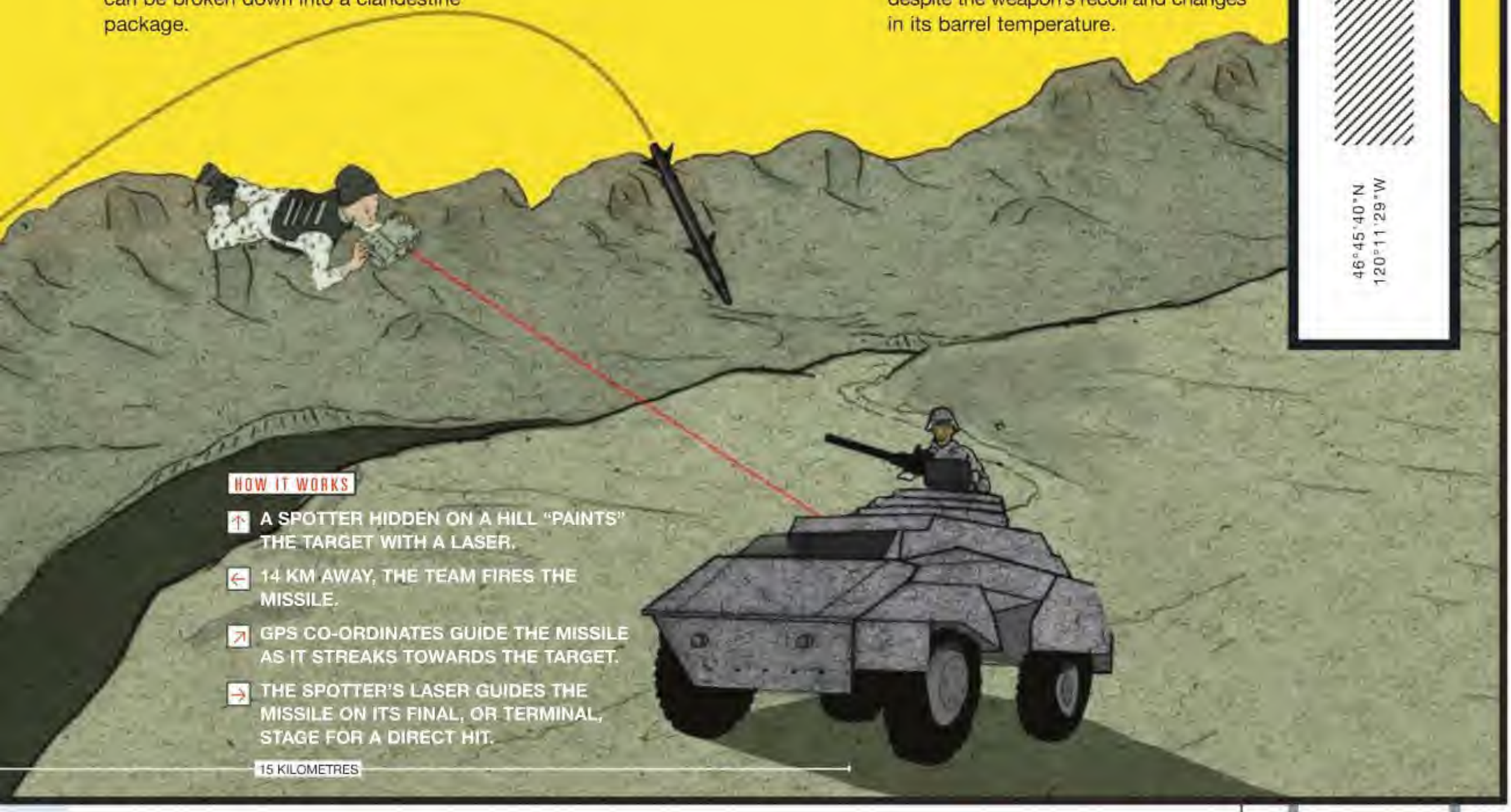


Illustration by Miguel Manzur

THE SOFT SIDE OF SPECIAL OPS

When most people think of special operations, they think of lightning-fast raids that target terrorist leaders. The killing of Osama bin Laden was the capstone on a decade of aggressive wartime missions that the military calls direct-action, or kinetic, missions. Although presidents have virtually no control over the planning or execution of these missions, they can be elected or booted from office based on their outcomes. Just ask Jimmy Carter, who signed off on an ill-fated hostage rescue in Iran.

Direct action, with its associated stealthy recon, building breaches, helicopter abseiling and double-tap gunshots, fits a violent stereotype of spec ops that does not match the reality. SOCOM has another mandate: to prepare other nations to take care of themselves. "The selection process is very good at weeding out anyone who wants only to shoot people in the face," Alpha says. "We need warrior-politicians."

These "indirect-action" missions include training foreign troops and teaching locals how to establish responsible governments. The strategy also promotes economic development by building bazaars, encouraging farmers to grow extra food crops to sell, and constructing roads. No one makes video games based on indirect-action missions.

The public may not have a good grasp on SOCOM's activities, but Washington, DC, is increasingly relying on its broad mandate to counter global instability. Since 2001, SOCOM's ranks have doubled and are funded to grow from 66 100 to 71 100 by 2015. Its budgets tripled since 2001 to a 2012 tally of more than R80 billion. The tempo of deployments has risen too, the command's personnel (not all A-Teams) now work in at least 75 nations, 15 more than the total at the end of the Bush administration. "I expect the operational demands placed on special operations forces to increase across the next decade and beyond," McRaven says.

SOCOM has become the US government's tool of choice for soft power projection, but this is partly by default. "Most of our resources, when it comes to these types of efforts, are placed in the Department of Defence," says Rick Nelson, a senior fellow with the Centre for Strategic and International Studies, who served with Joint Special Operations Command. "The reality is that the State Department and USAID are not funded at appropriate levels."

46°45'40"N
120°11'29"W

This team has less than a year to prepare for deployment to Afghanistan. The operators are prepared to fight, but the emphasis is on building a local force to repel insurgents: one day is spent on mortar training, six weeks on learning the Pashto language.

Spec ops has become a tempting option for civilian policymakers. Teams are easy to send into the field because they can be deployed with little disclosure to the public or to regional allies, minimal advance warning and fewer bureaucratic approvals. "The US government is at risk of seeing SOF as a panacea for all of America's security problems in the world," Travis Sharp says. "There is a reasonable limit to what they can accomplish and remain sustainable."

The nation-building aspect of SOCOM's work is increasing as the war efforts recede and kill/capture raids become rarer. But those who assist SOCOM – Congress, which pays, and conventional forces, who contribute airlift, bases and support personnel – may not be eager to aid the kinder, gentler SOCOM missions.

"The spotlight has been on the kinetic operations against high-value targets," says Admiral Eric Olson, former head of SOCOM. "Everybody lines up to support those, with a full capability and budgets." His concern is that as SOF leave battlefields, the smaller, less violent operations won't get the attention they need: "Instead of having the spotlight on special operations forces shift, I think it will just dim."

ECHO ON WHEELS

The senior Echo is behind the wheel of a R3,8 million mine-resistant all-terrain vehicle, wearing his helmet, communications headset, and trademark grin. He's never driven an M-ATV without an instructor before today, but there's no hesitation as he manoeuvres the 14 500 kg behemoth across a mat of scrub brush at the Yakima Training Centre. "Real men drive big trucks," he says over the rumble of the idling 275 kW engine, adding: "As long as they're diesel."

The M-ATV is fun to take off-roading, but spec ops guys don't like them because they are loud and intimidating. Riding into a village in such a vehicle violates some of the core tenets of the team's mission: use what the locals have; project confidence; stay alert and manoeuvrable; relate on a human-to-human basis. "On a mission," Alpha says, "I'd just as soon walk."

But this is special operations, and the M-ATV has been modified to meet SOCOM's demands. The windscreen is wider, and there is a hatch in the back to allow a crew member (dubbed a trunk monkey) to man a mounted weapon. These M-ATVs also have a common remotely operated weapon station (CROWS) affixed to the roof. With it, a gunner in the back seat can scan the surroundings with the system's day/night optics and use a joystick to fire the machine gun at whatever's in the onscreen crosshairs.

The team uses two M-ATVs to practise an off-road advance called a bounding overwatch. One truck remains still, scanning for threats with the CROWS, as the second rolls through the scrub brush. When the M-ATV in motion finds a place with a good view, it stops, and the first truck then moves. It's a variation on an infantry advance, played out with heavy vehicles, remote-control cameras, and frightened field mice.

Today, the machine guns are left behind as the team practices communication and co-ordination. A-Team members must be quick learners. The Army's M-ATV official training schedule lasts about two weeks; Alpha's team has only five days. "You'll never catch anyone in special operations saying something can't be done," Alpha says. The next day, they'll mount guns on the CROWS, put a trunk monkey on an M249 squad automatic weapon, and drill on a range with live ammunition.

After the exercise ends, the team clusters on a hilltop to discuss how the bounding overwatch can be improved. In a spec ops A-Team, everyone is free to chime in with critiques. This collaborative atmosphere is a marked difference between conventional and special operations forces. All ranks call each other by first names (Alpha is still

SPECIAL OPS' GLOBAL SCOPE

03 LATIN AMERICA

Indirect action: Foreign internal defence

Objective: Promote military relationships with an annual competition, Fuerzas Comando.

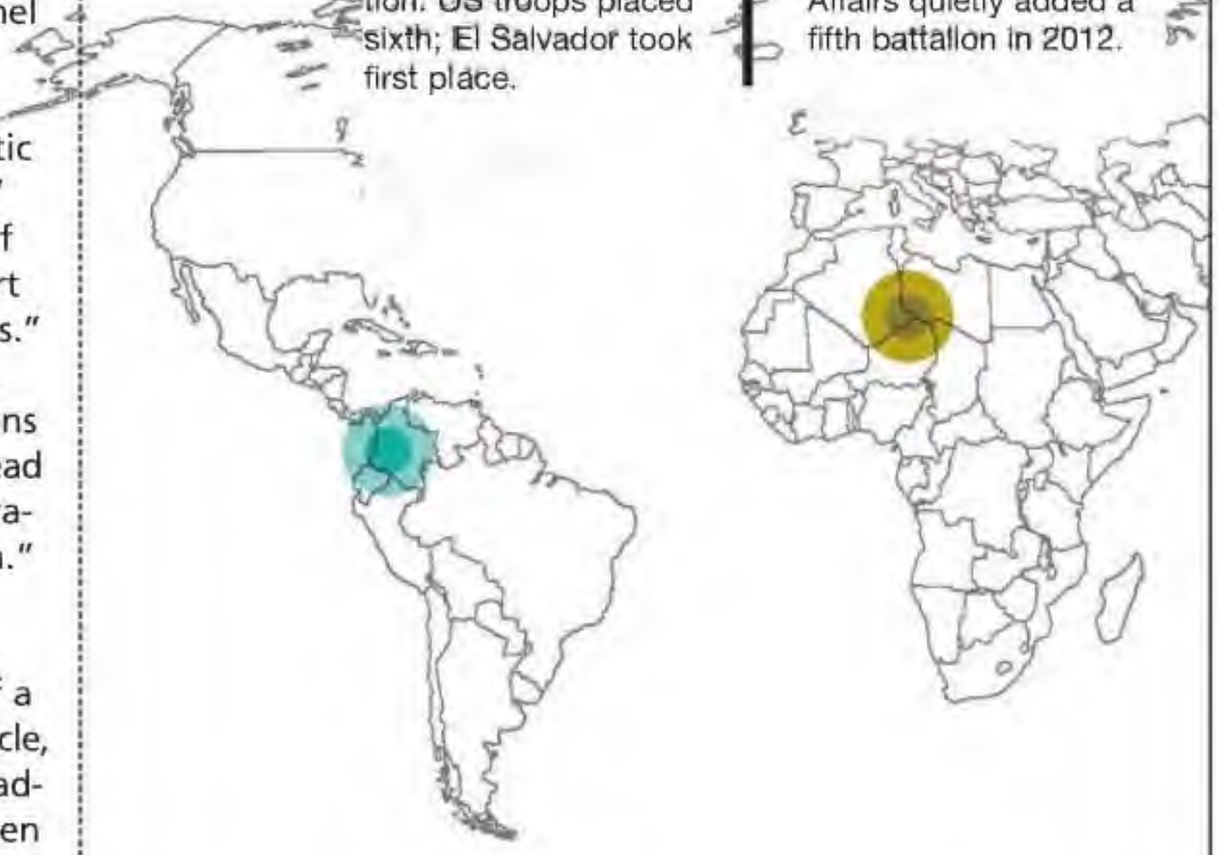
Update: Commandos from 19 countries participated in the 2011 competition. Events included a timed 18 km forced march, sniper contests, and a combined airborne operation. US troops placed sixth; El Salvador took first place.

04 TRANS-SAHARA

Indirect action: Civil-military support element

Objective: CMSE teams advise local governments on how to meet the needs of at-risk populations.

Update: CMSE teams from the 91st Civil Affairs battalion provide veterinary services, construction, and partnerships with reliable business leaders. This work is expanding; SOF Civil Affairs quietly added a fifth battalion in 2012.



LOOKING DOWNRANGE

"sir"). Leaders ask questions and solicit advice more than they bark orders; mission planning is done with everyone's involvement. The operators contribute critiques but rarely gripe. "It's a team, and so you need to get a consensus," Alpha says. "These are not guys who want to say 'yes, sir, no, sir' blindly."

It's easy to trust the level of dedication of SOF operators – they need direction, not micromanagement. "I was in the (conventional) army before this, and I worked with a lot of people who didn't want to be there. Everyone here really wants to be here," another junior Echo on the team says. "You feel much better about an operation when you're part of the planning."

SOCOM says the typical operator is 29 years old (officers average 34) and married with at least two kids. This team's stats are skewed by the senior Echo, who has nine children. Team members come from all over the country and represent a dizzying polyethnic mix: Korean American, black Asian, Malay Indonesian. Any demographic differences fade before the bond of their profession. "After this training, I'll put the guys on a four-day weekend," Alpha says. "It won't matter. They're just going to hang out more. This job consumes their lives."

The afternoon is spent towing an M-ATV. Alpha runs the drill as if the team is under attack and needs to get the crippled M-ATV out of the range of enemy weapons (the "kill zone".) Some operators pop out from the rescue vehicle to provide cover with M4 and SCAR-H rifles while the rest buckle a forearm-thick rope to the "stalled" M-ATV. The engine roars, the two vehicles jolt violently, and the lead M-ATV drags the other to safety.

The drill is a success, but the team runs it again anyway. This time the rope snaps; it may have snagged on metal or simply been used once too often. The severed line whips a bloom of brown dust off the massive spare tyre mounted on the M-ATV's rack. "It's not a full day in special operations until we break something," Alpha says. This time the Pentagon got off cheap.

GUERRILLA VS GUERRILLA

In Afghanistan, Alpha's team will try to create a local force, backed by a credible government, to keep the insurgent wolves at bay. "We are trained to be guerrillas," Alpha says. "Who'd be better at being counter-guerrillas?" The Pentagon calls them force multipliers for a reason. "Every guy is expected to lead one company-size element, up to 100 guys," Alpha says. "I'm supposed to lead a battalion, or 600 guys."

Every member of a 12-man special operations team has made himself into an avatar of the most idealised version of the nation he serves. The pressure is always on to appear perfect in front of conventional and foreign forces. "We always want to build the aura that we are masters of chaos and jacks-of-all-trades," Alpha says. "Expectations are really high. We have to give them what they expect."

The team's Charlie (construction and demolitions specialist) points out that there's a lot of diplomacy involved in being an elite warrior: "I could be talking to a (foreign army) colonel in the morning, and the provincial governor in the afternoon." He has no illusions about how hard it will be to operate in Afghanistan. "I could be heading out to the market to pick up lumber to build a school. Then we're told about an IED (improvised explosive device) and have to go handle it," he says. "Then back to the market, buy the supplies, distribute them, and do the accounting when I get back."

The attacks on Afghans who support the government in Kabul – and the United States – will only grow as 2014 approaches. The police units that spec ops teams train have been the targets of infiltration and murder. "We talk to guys who are over there now," Alpha says. "We're expecting a hard fight."

GOING HOT

With guns mounted on the roof and rear cargo area, the M-ATV is transformed from a truck to a war machine. The A-Team has mounted a .50-calibre machine gun on top of the M-ATV; an Echo seated inside the armoured vehicle uses a joystick and the CROWS' video screen to slew the weapon and pick targets.

"Okay, captain, are we going hot?" the gunner asks. "Yep," Alpha responds from the shotgun side of the front seat. "Cool."

Alpha scans outside the ballistic glass for cutout wooden targets scattered around the firing range. "Black truck silhouette at two o'clock." The landscape behind the reticule on the CROWS screen swings as the gun mounted on top swivels. "Contact," says the Echo, spotting the target. He presses a red button, bouncing a laser off the target to gauge its distance.

It's taking too long. "Engage targets," Alpha prompts. The .50-calibre thumps and those inside can hear the shattered crystalline sound of shell casings cascading across the hull. Red tracers bounce off rocks and carom 10 m into the air at crazy angles. The targets are instrumented to fall after a designated number of rounds hit; one by one they drop, ventilated by heavy bullets. "Alpha, this is Zulu," the senior non-enlisted man radios from the other truck, an older RG-33 that has an M240 mounted in its CROWS. "We are moving into position."

The RG-33 rolls as the M-ATV provides covering fire. When both trucks are in position, they concentrate their attack on the same targets. The vehicles rattle through hundreds of .50-calibre and 7,62-mm rounds.

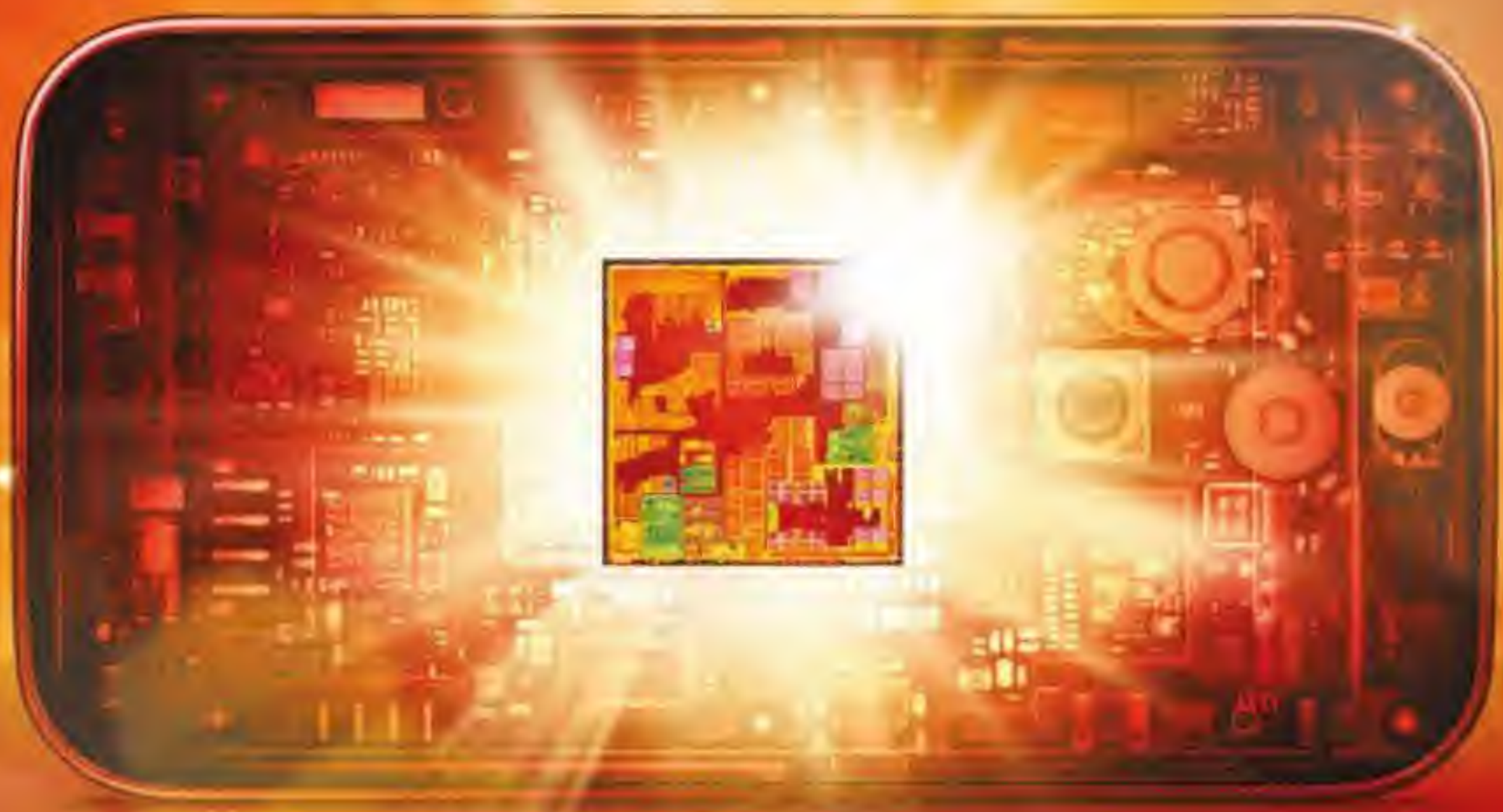
The exercise ends and the huddle re-convenes. Details are discussed: advantages of the CROWS' camera stabilisation, the importance of the gunner's use of the laser rangefinder to communicate distance to the front-seat spotters, and the best way for the leapfrogging vehicles to communicate. The sun bows to the horizon, outlining silhouettes of distant, sharp mountain peaks. The team runs the exercise again – and again. "We drill on the basics until we're perfect," Alpha says. "That's what makes us special."

By the time they return from the day's last gun run, darkness has fallen. Rock-hard pears, a slab of pale turkey and sickly, over-sweetened yams await them for a dusty dinner at the range. They eat by the light of the M-ATV headlights. After the grim meal, the weapons are dismounted, extra ammo stowed, and worn, wooden "Danger Live Fire" warning signs are collected from the range. "This is the tempo," Alpha says.

Then it's back to the barracks to clean the weapons. The team won't finish until 1 am. Alpha and Zulu will then complete reports and finalise the training schedule for the next day. By the time they lie down in their barracks, PT is only a few hours away. **PM**

LOOKING DOWNRANGE

snapdragon™
by Qualcomm



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INCOGNITO

David Eagleman is a neuroscientist at the Baylor College of Medicine in Houston, where he heads up the Laboratory for Perception and Action. His latest book explores the exciting – and occasionally alarming – subsurface of the human mind, raising questions that are not easily answered. Example: How is it possible to get angry at yourself? Who, exactly, is mad at whom? As Pink Floyd put it, "There's someone in my head, but it's not me..."

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Take a close look at yourself in the mirror. Beneath your dashing good looks churns a hidden universe of networked machinery. The machinery includes a sophisticated scaffolding of interlocking bones, a netting of sinewy muscles, a good deal of specialised fluid, and a collaboration of internal organs chugging away in darkness to keep you alive. A sheet of high-tech self-healing sensory material that we call skin seamlessly covers your machinery in a pleasing package.

And then there's your brain. About 1,4 kg of the most complex material we've discovered in the Universe. This is the mission control centre that drives the whole operation, gathering dispatches through small portals in the armoured bunker of the skull. Your brain is built of cells called neurons and glia – hundreds of billions of them.

Each one of these cells is as complicated as a city. And each one contains the entire human genome and traffics billions of molecules in intricate economies. Each cell sends electrical pulses to other cells, up to hundreds of times per second. If you represented each of these trillions and trillions of pulses in your brain by a single photon of light, the combined output would be blinding.

The cells are connected to one another in a network of such staggering complexity that it bankrupts human language and necessitates new strains of mathematics. A typical neuron makes about ten thousand connections to neighbouring neurons. Given the billions of neurons, this means there are as many connections in a single cubic centimetre of brain tissue as there are stars in the Milky Way galaxy. The 1,4 kg organ in your skull – with its pink consistency of jelly – is an alien kind of computational material. It is composed of miniaturised, self-configuring parts, and it vastly outstrips anything we've dreamt of building. So if you ever feel lazy or dull, take heart: you're the busiest, brightest thing on the planet.

Ours is an incredible story. As far as anyone can tell, we're the only system on the planet so complex that we've thrown ourselves headlong into the game of deciphering our own programming language. Imagine that your desktop computer began to control its own peripheral devices, removed its own cover, and pointed its webcam at its own circuitry. That's us.

And what we've discovered by peering into the skull ranks among the most significant intellectual developments of our species: the recognition that the innumerable facets of our behaviour, thoughts and experience are inseparably yoked to a vast, wet, chemical-electrical network called the nervous system. The machinery is utterly alien to us, and yet, somehow, it is us.

THE TREMENDOUS MAGIC

In 1949, Arthur Alberts travelled from his home in Yonkers, New York, to villages between the Gold Coast and Timbuktu in West Africa. He brought his wife, a camera, a jeep, and – because of his love of music – a jeep-powered tape recorder. Wanting to open the ears of the western world, he recorded some of the most important music ever to come out of Africa. But Alberts ran into social troubles while using the tape recorder. One West African native heard his voice played back and accused Alberts of "stealing his tongue". Alberts only narrowly averted being pummelled by taking out a mirror and convincing the man that his tongue was still intact.

It's not difficult to see why the natives found the tape recorder so counterintuitive. A vocalisation seems ephemeral and ineffable: it is like opening a bag of feathers that scatter on the breeze and can never be retrieved. Voices are weightless and odourless, something you cannot hold in your hand.

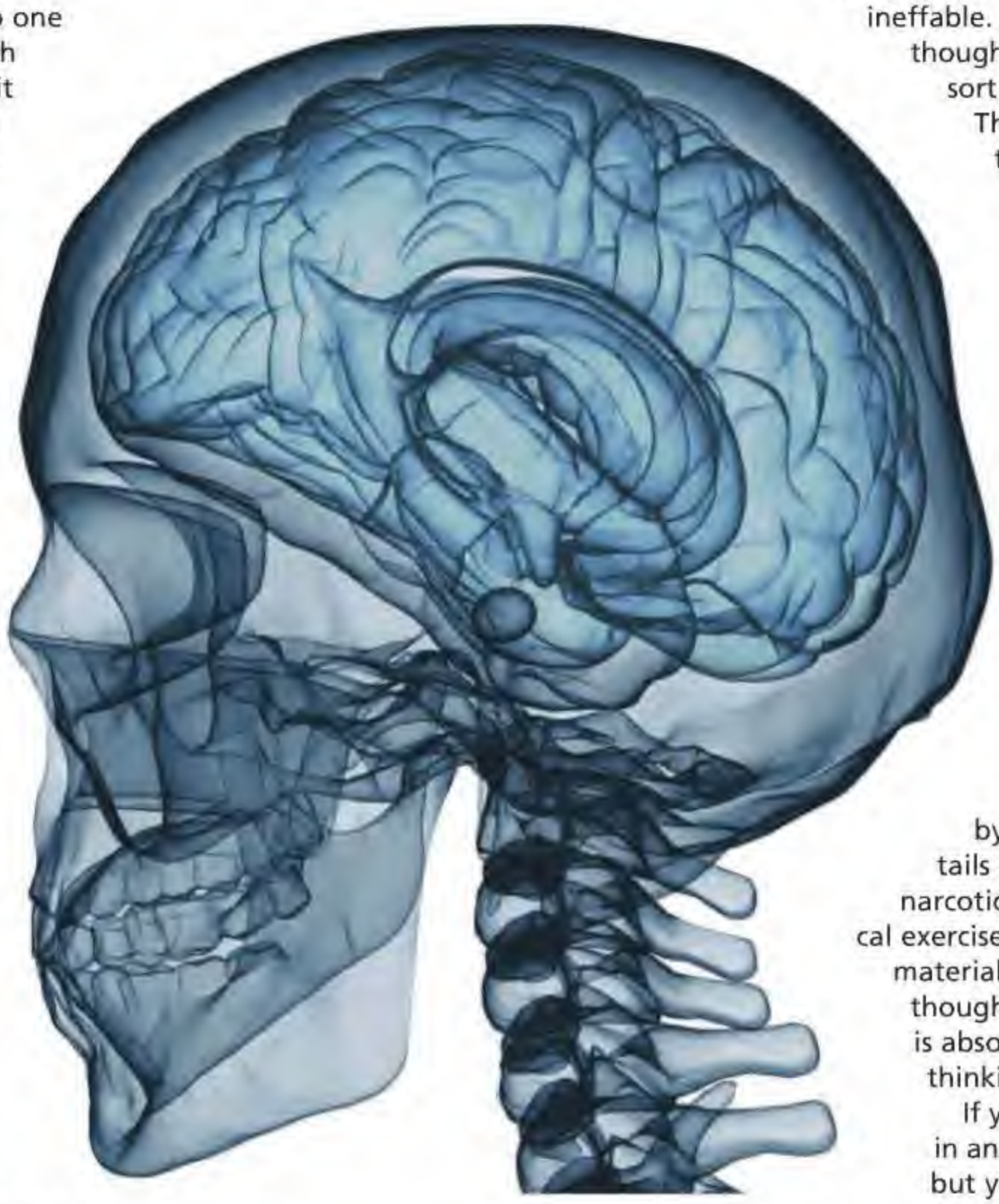
So it comes as a surprise (to learn) that a voice is physical. If you build a little machine sensitive enough to detect tiny compressions of the molecules in the air, you can capture these density changes and reproduce them later. We call these machines microphones, and every one of the billions of radios on the planet is proudly serving up bags of feathers once thought irretrievable. When Alberts played the music back from the tape recorder, one West African tribesman depicted the feat as "tremendous magic".

And so it goes with thoughts. What exactly is a thought? It doesn't seem to weigh anything. It feels ephemeral and ineffable. You wouldn't think that a thought has a shape or smell or any sort of physical instantiation.

Thoughts seem to be a kind of tremendous magic. But just like voices, thoughts are underpinned by physical stuff. We know this because alterations to the brain change the kinds of thoughts we can think.

In a state of deep sleep, there are no thoughts. When the brain transitions into dream sleep, there are unbidden, bizarre thoughts. During the day we enjoy our normal, well-accepted thoughts, which people enthusiastically modulate by spiking the chemical cocktails of the brain with alcohol, narcotics, cigarettes, coffee or physical exercise. The state of the physical material determines the state of the thoughts. And the physical material is absolutely necessary for normal thinking to tick along.

If you were to injure your pinkie in an accident, you'd be distressed, but your conscious experience



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would be no different. By contrast, if you were to damage an equivalently sized piece of brain tissue, this might change your capacity to understand music, name animals, see colours, judge risk, make decisions, read signals from your body, or understand the concept of a mirror – thereby unmasking the strange, veiled workings of the machinery beneath.

Our hopes, dreams, aspirations, fears, comic instincts, great ideas, fetishes, senses of humour and desires all emerge from this strange organ – and when the brain changes, so do we. So although it's easy to intuit that thoughts don't have a physical basis, that they are something like feathers on the wind; they in fact depend directly on the integrity of the enigmatic, three-pound mission control centre.

The first thing we learn from studying our own circuitry is a simple lesson: most of what we do and think and feel is not under our conscious control. The vast jungles of neurons operate their own programs. The conscious you – the *I* that flickers to life when you wake up in the morning – is the smallest bit of what's transpiring in your brain. Although we are dependent on the functioning of the brain for our inner lives, it runs its own show. Most of its operations are above the security clearance of the conscious mind. The *I* simply has no right of entry.

Your consciousness is like a tiny stowaway on a transatlantic steamship, taking credit for the journey without acknowledging the massive engineering underfoot. This book (*Incognito*) is about that amazing fact: how we know it, what it means, and what it explains about people, markets, secrets, strippers, retirement accounts, criminals, artists, Ulysses, drunkards, stroke victims, gamblers, athletes, bloodhounds, racists, lovers, and every decision you've ever taken to be yours.

In a recent experiment, men were asked to rank how attractive they found photographs of different women's faces. The photos were 20 by 25 cm, and showed women facing the camera or turned in three-quarter profile. Unbeknownst to the men, in half the photos, the eyes of the women were dilated, and in the other half they were not. The men were consistently more attracted to the women with dilated eyes.

Remarkably, the men had no insight into their decision-making. None of them said, "I noticed her pupils were two millimetres larger in this photo than in this other one". Instead, they simply felt more drawn toward some women than others, for reasons they couldn't quite put a finger on.

So who was doing the choosing? In the largely inaccessible workings of the brain, something knew that a woman's dilated eyes correlates with sexual excitement and readiness. Their brains knew this, but the men in the study didn't – at least not explicitly. The men may also not have known that their notions of beauty and feelings of attraction are deeply hard-wired, steered in the right direction by programs carved by millions of years of natural selection. When the men were choosing the most attractive women, they didn't know that the choice was not theirs, really, but instead the choice of successful programs that had been burned deep into the brain's circuitry over the course of hundreds of thousands of generations.

Brains are in the business of gathering information and steering behaviour appropriately. It doesn't matter whether consciousness is involved in the decision-making. And most of the time, it's not. Whether we're talking about dilated eyes, jealousy, attraction, the love of fatty foods, or the great idea you had last week, consciousness is the smallest player in the operations of the brain. Our brains run mostly on autopilot, and the conscious mind has little access to the giant and mysterious factory that runs below it.

You see evidence of this when your foot gets halfway to the brake before you consciously realise that a red Toyota is backing out of a driveway on the road ahead of you. You see it when you notice your name spoken in a conversation across the room that you thought you weren't listening to, when you find someone attractive without knowing why, or when your nervous system gives you a "hunch" about which choice you should make.

The brain is a complex system, but that doesn't mean it's incomprehensible. Our neural circuits were carved by natural selection to solve problems that our ancestors faced during our species' evolutionary history. Your brain has been moulded by evolutionary pressures just as your spleen and eyes have been. And so has your consciousness. Consciousness developed because it was advantageous, but advantageous only in limited amounts.

Consider the activity that characterises a nation at any moment. Factories churn, telecommunication lines buzz with activity, businesses ship products. People eat constantly. Sewer lines direct waste. All across the great stretches of land, police chase criminals. Handshakes secure deals. Lovers rendezvous. Secretaries field calls, teachers profess, athletes compete, doctors operate, bus drivers navigate. You may

'In each of us there is another whom we do not know' – Carl Jung

iStockphoto/Steve Greer

'There's someone in my head, but it's not me' – Pink Floyd

wish to know what's happening at any moment in your great nation, but you can't possibly take in all the information at once.

Nor would it be useful, even if you could. You want a summary. So you pick up a newspaper – not a dense paper like the *New York Times* but lighter fare such as *USA Today*. You won't be surprised that none of the details of the activity are listed in the paper; after all, you want to know the bottom line. You want to know that Congress just signed a new tax law that affects your family, but the detailed origin of the idea – involving lawyers and corporations and filibusters – isn't especially important to that new bottom line. And you certainly wouldn't want to know all the details of the food supply of the nation – how the cows are eating and how many are being eaten. You want to be alerted only if there's a spike of mad cow disease. You don't care how the garbage is produced and packed away; you care only if it's going to end up in your back yard. You don't care about the wiring and infrastructure of the factories; you care only if the workers are going on strike. That's what you get from reading the newspaper.

Your conscious mind is that newspaper. Your brain buzzes with activity around the clock, and, just like the nation, almost everything transpires locally: small groups are constantly making decisions and sending out messages to other groups. Out of these local interactions emerge larger coalitions.

By the time you read a mental headline, the important action has already transpired, the deals are done. You have surprisingly little access to what happened behind the scenes. Entire political movements gain ground-up support and become unstoppable before you ever catch wind of them as a feeling or an intuition or a thought that strikes you. You're the last one to hear the information.

However, you're an odd kind of newspaper reader, reading the headline and taking credit for the idea as though you thought of it first. You gleefully say, "I just thought of something!", when in fact your brain performed an enormous amount of work before your moment of genius struck. When an idea is served up from behind the scenes, your neural circuitry has been working on it for hours or days or years, consolidating information and trying out new combinations. But you take credit without further wonderment at the vast, hidden machinery behind the scenes.

And who can blame you for thinking you deserve the credit? The brain works its machinations in secret, conjuring ideas like tremendous magic. It does not allow its colossal operating system to be probed by conscious cognition. The brain runs its show incognito.

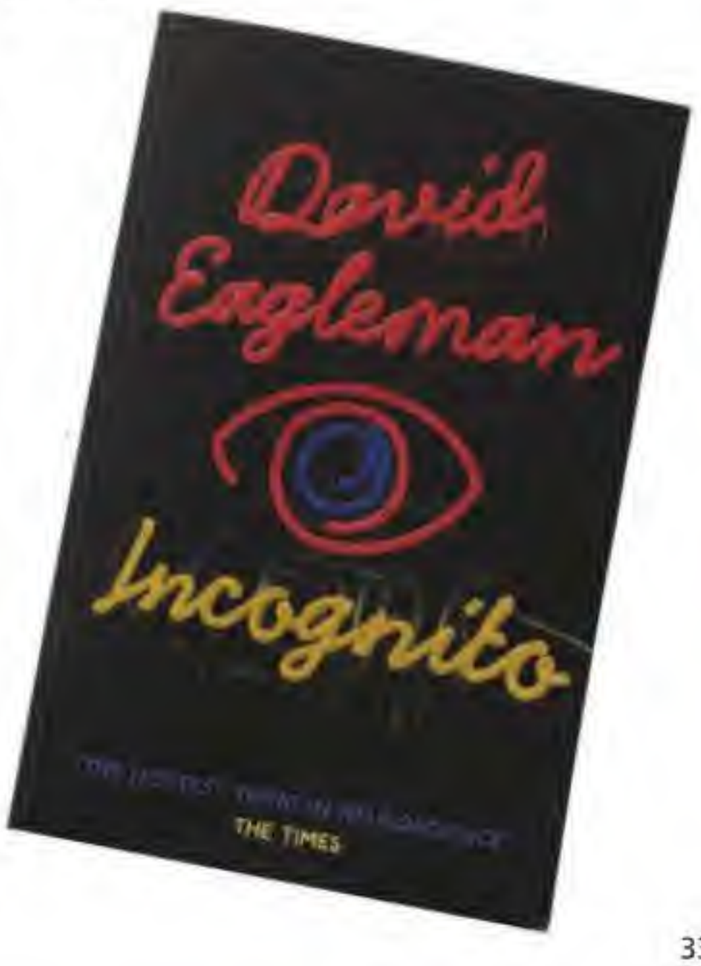
So who, exactly, deserves the acclaim for a great idea? In 1862, the Scottish mathematician James Clerk Maxwell developed a set of fundamental equations that unified electricity and magnetism. On his deathbed, he coughed up a strange sort of confession, declaring that "something within him" discovered the famous equations, not he. He admitted he had no idea how ideas actually came to him – they simply came to him.

William Blake related a similar experience, reporting of his long narrative poem, *Milton*: "I have written this poem from immediate dictation twelve or sometimes twenty lines at a time without premeditation and even against my will." Johann Wolfgang von Goethe claimed to have written his novella, *The Sorrows of Young Werther*, with practically no conscious input, as though he were holding a pen that moved on its own.

And consider the British poet, Samuel Taylor Coleridge. He began using opium in 1796, originally for relief from the pain of toothaches and facial neuralgia – but soon he was irreversibly hooked, swigging as much as two quarts of laudanum each week. His poem, *Kubla Khan*, with its exotic and dreamy imagery, was written on an opium high that he described as "a kind of a reverie". For him, the opium became a way to tap into his subconscious neural circuits. We credit the beautiful words of *Kubla Khan* to Coleridge because they came from his brain and no else's, right? But he couldn't get hold of those words while sober, so who exactly does the credit for the poem belong to?

As Carl Jung put it, "In each of us there is another whom we do not know." As Pink Floyd put it, "There's someone in my head, but it's not me". **PM**

● Extracted from *Incognito*, by David Eagleman. Published by Canongate, and available from all good bookstores (R150).



NEW ON THE BLOCK

> COMPILED BY ANTHONY DOMAN > anthony@ramsaymedia.co.za

GOING TO EXTREMES

The most powerful C-Class ever and a more potent track-oriented GT version of the SLS roadster headline the latest updates from Merc's AMG performance division.

MERCEDES-BENZ C63 AMG COUPÉ BLACK SERIES

With a 380 kW 6,3-litre V8 engine, the acceleration figure of zero to 100 km/h in 4,2 seconds and an electronically limited top speed of 300 km/h seem no less than you'd expect from the fearsome-looking C63 coupé in Black Series trim. Maximum torque is an eye-popping 620 N.m, by the way. In an attempt to channel at least some of this monumental urge to the road, this clearly track-focused vehicle comes with adjustable AMG coil-over sports suspension as standard, but for those with loftier ambitions will probably opt for the optional AMG Track package and Aerodynamics package.

The Track package includes sports tyres and active rear-axle transmission cooling; the Aerodynamics package adds flics, a functionally tuned front splitter and an adjustable carbon-fibre rear aerofoil.

Tricks of the trade.

(1) Coil-over sports suspension. AMG describes its sports suspension as a sophisticated new development. This kind of design, a motorsport staple, is characteristic of the Black Series model. Benefits include a range of setting options to tailor a very personal set-up.

(2) Flics. Made of carbon fibre and located on the front apron, these help optimise the car's aero characteristics.

Price: from R1 425 000.

MERCEDES-BENZ SLS AMG GT

This one is not for the faint-hearted. The new SLS AMG GT heads definitively trackwards with peak output of its built-by-one-man 6,3-litre V8 raised to 435 kW (achieved largely by what Merc calls in-engine "dethrottling"), optimised Speedshift DCT 7-speed sports transmission and redeveloped suspension. Model-specific cosmetic tweaks add to the overall effect of supreme athleticism, but there's no question that this latest iteration of the gullwing roadster is all about performance. The GT reaches 100 km/h from standstill in a breathtaking 3,7 seconds and doubles that speed in another 7,5 seconds. The top speed is an almost academic 320 km/h. Which, by the way, is electronically limited.

BENTLEY CONTINENTAL GT SPEED

HOLD ON TO YOUR TOP HAT

The fastest-ever production model has thundered off the Bentley production line. Due to make its international debut at this year's Goodwood Festival of Speed, the Continental GT Speed is said to be able to reach 329 km/h. For the imperialists among us, that's 205 mph.

Features include lowered, uprated suspension, sharper steering, signature Speed design cues, Mulliner Driving Specification cabin and new close-ratio 8-speed automatic transmission that helps improve economy and CO_2 emissions by 12 per cent overall.

Bentley's 6-litre, 48-valve, four-cam, twin turbo-charged W12 has been uprated to produce 460 kW/ 800 N.m. It reportedly dispatches the 0 – 100 km/h sprint in 4,2 seconds.

Permanent all-wheel drive, standard on all Continental models, uses a central Torsen differential.

Bloodline. Bentley says that inspiration for the GT Speed came from the legendary Speed models dating from 1923, based on the existing 3-litre. The coveted 3-litre Speed Model featured twin SU carburettors and a higher compression ratio engine.

JUST ASKING

WHY AREN'T WE ALL USING ADAPTIVE BRAKE LIGHTS?

In 2002, BMW introduced a controversial redesign of its 7 Series that included one subtle but potentially important innovation: adaptive brake lights. These lights, sometimes called emergency stop signals (ESS), illuminate an extra element during hard braking to, hopefully, add urgency to the warning to cars behind you. BMW now includes these lights on its entire product line, and other manufacturers have experimented with various ESS systems (including ones that blink or get brighter). Doesn't this seem like a technology that, if standardised and made universal, could reduce rear-end collisions as well as the overbraking that leads to accordion traffic? The US National Highway Traffic Safety Administration has been studying ESS since 2002 but currently has no official plan for the technology – despite research that suggests some ESS methods could be effective. We think it's time to figure out what works and run with it.

– GLENN DERENE

BMW 6 SERIES GRAN COUPÉ

PLUS TWO

BMW has been slow to the whole idea of the "four-door coupé", but here it finally is, in the wake of the convertible and Coupé in the 6 Series range. It's also the opportunity to introduce (in the 650i) a new, more efficient TwinPower Turbo V8 producing 330 kW and mated with an eight-speed Sport automatic transmission and proven BMW EfficientDynamics technology. Six-cylinder engines are available in the 640 petrol- or diesel-engined versions.

As you'd expect in an upscale model, the range of standard features runs on and on: ECO PRO Mode, Xenon headlights, automatic 2-zone air conditioning, leather upholstery and electric seat adjustment with memory function. Optional equipment Adaptive LED Headlights and the Bang & Olufsen High-End Surround Sound System.

Although the Gran Coupé is to a large extent about style, it has its practical dimensions. There's a 4+1 seating arrangement that provides space for a third rear passenger on short journeys and the boot volume of 460 dm^3 can be expanded to 1 265 dm^3 thanks to the through-loading system and the folding rear seatbacks.

THE TECH INSIDE

AUTONOMOUS EMERGENCY BRAKING

LOOK MA, NO FEET

Move over, airbags and stability control – the new buzzword in safety circles is Autonomous Emergency Braking.

Research suggests that Autonomous Emergency Braking systems can reduce accidents by up to 27 per cent, saving around 8 000 lives and preventing many more serious injuries and whiplash claims each year. Despite this, the technology has been made available only on around one in five new cars. Two-thirds of manufacturers do not offer the technology at all.

Although AEB is generally restricted to premium brands as a standard fitment – notably Volvo, Infiniti and Mercedes – it's increasingly being offered on mass-market cars as an option. That movement is likely to gain traction now that the Euro NCAP new-car crash test programme has indicated its intention to include these braking systems in its assessments from 2014.

The independent safety organisation says that AEB can go a long way towards cutting the road death toll and is calling for it to be fitted as standard to new cars.

Besides the aforementioned makes, Jaguar, Range Rover, Audi and Lexus are among the leading brands offering AEB as an option in executive and large family cars. However, Mazda, Ford, Honda and Volkswagen offer affordable AEB systems partly as standard or optional on models such as the Mazda CX-5, Ford Focus, Honda Civic and the VW up! According to Euro NCAP, Fiat will also make AEB a low-cost option on the new Panda in July 2012.

AEB is increasingly being made available as cars are replaced by new or facelifted models, such as the Mercedes-Benz A-Class, the Ford Fiesta and Ford Kuga.

Euro NCAP secretary-general Michiel van Ratingen says that faster penetration of these technologies into new cars will make it more realistic for the European Union to reach its target to halve road deaths by 2020. He said it's hoped that European authorities will soon require AEB as mandatory on all new vehicle types.

Stakeholders were given demonstrations of the state of the AEB art at Autoworld in Brussels recently as part of Euro NCAP's 15th anniversary commemorations.

How it works. Autonomous Emergency Braking systems can help to avoid crashes or to mitigate their severity by warning the driver and supporting his braking response, or by applying the brakes independently, or both. The technology generally uses forward-looking radar, lidar and video systems to provide a complete, accurate, real-time image of the road ahead.

TESLA MODEL S INTO THE MAINSTREAM

Premium sedan makes such as BMW are in Tesla's sights as the company's latest EV, the Model S sedan, hits the road. Its range: more than 400 km. The car has already received 10 000 pre-orders.

According to Tesla, the Model S is the world's first premium sedan to be built from the ground up as an electric vehicle. The five-door premium sedan competes with the top cars in its class in spaciousness, handling and style, yet produces zero emissions.

The all-electric model S takes up to five hours to charge, and performance figures include 0 to 100 km/h in about 4,5 seconds and a top speed of over 200 km/h (based on the 85 kWh version).

Could this sedan be the car that finally puts decent amounts of black ink on the balance sheet for the pioneering manufacturer that rewrote the EV rulebook by starting out with an electric sports car that has sold, to date, about 2 300 units?

Tesla is looking to build 5 000 cars by the end of 2012, followed by 20 000 cars in 2013. "In 2009, we set out to build the most innovative car of the 21st century, and since then have dedicated ourselves to developing and testing Model S to ensure that under any situation, Model S never disappoints," said Elon Musk, Tesla Motors co-founder and CEO. "Today we achieved our goal with an exceptional car that we believe sets a new standard for efficiency, safety, style, technology, operating cost and performance."

The Model S has set a new EPA record for electric vehicle range of 425 km. There are three battery options: 40 kWh, 60 kWh and 85 kWh. Tesla says the battery's floor-mounted position gives Model S a low centre of gravity and ideal weight distribution for exhilarating performance and superior handling. It also shares many similarities – notably responsiveness, instant torque and smooth acceleration – with the company's Roadster model.

However, the Model S is not going to be a cheap proposition. Tesla quotes an after-tax-credit price of about R400 000 in the US, though this is said to be a cheaper model. Other reports suggest that prices are more likely about R800 00.

Reinventing the car-buying experience.

Tesla has designed a unique retail model, with stores that feature a hands-on exhibit of the Model S drivetrain, a Design Studio where buyers can customise their own Model S, and an interactive touch-screen experience designed to engage and inform customers about the company's technology and the benefits of driving electric. Reservations are being taken online and at the company's 22 retail stores and galleries around the world (most of them, admittedly, in North America). Home delivery with a product specialist conducting a handover process is available.

YOKOHAMA AVID ASCEND

PEELING OUT

Manufacturing tyres has always been a compromise between traction, tread life and rolling resistance. According to Yokohama engineers, you had to "pick one, blend two, or average three". But those same engineers claim that, by replacing some of the petroleum typically used in tyres with a bit of oil derived from orange peels, they can mitigate the typical compromises. The result is a low-rolling-resistance tyre that can go for more than 80 000 kilometres yet still effectively grip the road.

The company has been very cagey about the details and won't say how much orange oil it uses per tyre. As one engineer cryptically put it, the orange oil is "a percentage of a percentage of a percentage" of the tyre. In other words, you won't smell oranges when you do burnouts. But the Avid Ascend, the new orange oil tyre that's available in 45 sizes, includes remarkable treadlife warranties from about 100 000 to 140 000 km. Plus, the company claims a 20 per cent reduction in rolling resistance compared with a typical conventional tyre. That will save some fuel, but probably not enough that you'd notice.

We sampled the tyres and found them to be quiet and supple, not at all like the usual stone-hard rolling-resistance tyres. We didn't notice any susceptibility to tracking in road ruts, and in the corners there was adequate grip. Our observations are hardly scientific, but we were sufficiently impressed that we'd consider buying these when it's time for new tyres. They're slightly more expensive, but with such long tread lives, you should, in the end, come out ahead.

Picture by Dan Saelinger

General Motors South Africa
introduces
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General Motors South Africa introduces the GM-owned ACDelco Brand.

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12 MONTH WARRANTY

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MAINTENANCE MADE EASY

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12 MONTH WARRANTY

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PROTECTS UNDER ANY CONDITION

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- Enhances engine cleanliness
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12 MONTH WARRANTY

Wiper Blades

KEEP A CLEAR VIEW

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12 MONTH WARRANTY

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SPARK UP YOUR DRIVE

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- Reliable and efficient in any operating conditions

12 MONTH WARRANTY

Available through GMSA dealers.
Ask for ACDelco.

12 MONTH ACDelco WARRANTY

QUALITY AUTOMOTIVE PARTS

ACDelco

2013 SRT VIPER

SHOWSTOPPER

As a left-hand-drive car, the Viper is not likely to be seen on South African roads legally any time soon. However, it's hardly fair to deprive local Pentastar fans of their fix, even if it is just in print – so we hereby present the latest version of the Super Snake. It's entirely appropriate, too, because the 2013 SRT Viper stole the spotlight at this year's New York International Auto Show. Along with a new badge and a 477 kW V10, the much-awaited supercar features a modern and more functional take on its iconic shape, which dates to 1992. Here, Ralph Gilles, president and CEO of SRT, Chrysler senior vice-president of design, and designer of the Chrysler 300, explains the Viper's new look. – *ANDREW DEL-COLLE*

A. PROPORTION

The Viper is what we call a cab-rearward proportion. It has a distinctive back-positioned cab with a very, very long nose. This allows the car to be a front-midengine car, where the engine is rearward of the front axle and gives the car 50/50 weight distribution.

B. BONNET EXHAUSTS

The two new air extractors increase top speed a little bit, decrease pressure build-up on the nose of the car, and improve cooling by releasing hot air from the radiator. We shaped those scoops so the hot air goes around the windshield, not in the passenger compartment.

C. FRONT HEADLAMPS

The Viper's eyes have been horizontal slits with multiple headlamp projectors for a long time. We went to just a single projector and literally styled the eyes of the car after a snake's, just a little bit more vertically oriented. The two LEDs – the upper is a turn signal; the lower is the daytime running light – almost appear to be pupils.

"We wanted it to look like an organism, not a machine."
– *Ralph Gilles*

D. SIDE GILL

The side gill is unmistakably a Viper cue and helps remove air pressure and heat from the engine bay. This gill is almost two-and-a half times as wide as it's ever been, and 100 per cent functional. In the past, it's only been decorative.

E. DIFFERENTIAL COOLING DUCTS

A performance car's differential works hard and gets pretty hot – almost hotter than any other part – so we designed an air path for cooling. The ducts also modernise and lengthen the canopy of the vehicle.

F. ROOF TAB

The tab that extends off the roof accentuates the double bubble and minimises the appearance of the rear window. This gives the rear wheel arches prominence; they bulge because that's where the power comes from – the rear wheels.

G. DIFFUSER

The diffuser is a huge contributor to the downforce of the back of the car. I'm very proud of it. Although it looks sculpted, it's completely functional. We have integrated backup lamps that are kind of hidden in there. **PM**

Pictures by MONTE ISOM

Did you know that facing RDP houses north could save energy while pushing the room temperature up by 6 degrees in winter?

Well, that was one of the innovations at the *eta* Awards last year. Show us your bright new idea and how it saves energy, and you could win R30 000 in cash. The *eta* Awards recognises and rewards innovative energy saving ideas from homeowners, children and small companies, all the way to big corporates.

To find out more, visit: www.eta-awards.co.za

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A sharper FOCUS

Ford's new EcoBoost-powered Focus ST, billed as the company's first "global performance" model, ups the stakes in the hot hatch segment with a heady combination of vigorous performance, excellent handling, eye-catching looks and impressive fuel economy. We drove it in the south of France and emerged harmlessly infatuated.

They probably had a good laugh over at Ford's marketing department when someone came up with this name for a paint option: would you believe *Tangerine Scream*? Anyway, there was no mistaking its bold livery as we followed the leading Focus ST through the treacherous hairpins and switchbacks of the Côte d'Azur, where apparently deaf cyclists and irresponsible cellphone users posed almost as big a danger as the narrow roads and precipitous cliffs.

Let's say it right up front: this car is destined to significantly improve Ford's image (and concomitantly, its fortunes) in the realm occupied by warm-blooded motorists. Why do we say this? For starters, there's the gutsy, flexible, deliciously rorty (our choice from several definitions: "boisterous and high-spirited") powerplant – a 2-litre, 4-cylinder turbocharged EcoBoost engine producing a useful 184 kW. Driven in anger, or perhaps we should say "high spirits", this car feels as if it has a far bigger engine under the bonnet.

It performs its magic through a combination of high-pressure direct injection, low-inertia turbocharging, twin-independent variable cam timing, redesigned intake and exhaust systems, and unique calibration. The 0-100 km/h sprint is accomplished in 6,5 seconds and top speed is just under 250 km/h. If you care about fuel consumption (and don't we all?), you should know that it returns a distinctly frugal 7,2 l/100 km, representing a 20 per cent improvement over the previous Focus ST.

Apparently some people groan when they encounter the word "torque" in a car review, dismissing it as unnecessarily "technical"; however, this is silly. When we tell you that the Focus ST's engine has a broad, flat torque curve peaking at 360 N.m, it means that it's equipped to accelerate with great enthusiasm and propel you up steep hills with nary a protest. (In short, lots of torque is a good thing.) Not that the Focus ST seemed to need it on the twisty roads of southern France; the slick-shifting manual transmission, with its revised ratios, extracted more than adequate punch across the range.

We loved the steering, which employs a variable-ratio rack that reduces sensitivity when driving in a straight line and increases it when cornering, allowing for comfortable highway cruising as well as needle-sharp turns on hairpins. One of these was a first-gear bend that gave us an opportunity to appreciate the car's tight turning circle; without it, we would undoubtedly have encroached on someone else's, equally narrow piece of mountain pass (this, it goes without saying, could have been messy).

Specially calibrated for the new Ford Focus, the steering system detects and counters torque steer with a more aggressively pitched version of Ford's torque steer compensation technology. It doesn't disappear entirely, but then again, most of us need to be reminded that flooring the gas pedal in first or second gear brings a few relevant phenomena into play.

Want to feel in control? The Electronic Stability Programme (ESP) offers three modes: you can turn it on for a tuned version of the system found throughout the Focus range, opt for a reduced or wide-slip mode that disables traction control and activates ESP only when absolutely necessary, or switch it off altogether. The torque-vectoring system (there is no mechanical differential) applies brake torque to the inner wheel through a corner to reduce understeer. The result is a car that holds its line, delivers outstanding feedback, and goes around corners like a sure-footed gazelle. More reassurance comes from a revised rear suspension with a number of new parts – including uprated suspension knuckles and a new anti-roll bar – developed especially for the ST.

Then there's the auditory treat. Dieter Schwarz, the amiable engineering manager

Form-hugging seats and driver-angled instruments create a distinctly sporty feel.

The Focus ST's aggressive design features a one-piece interpretation of Ford's signature trapezoidal grille, bulging side skirts and dynamic rear bumper with prominent diffuser-style vents in the lower fascia. And the roof spoiler? It improves high-speed stability and reduces drag. Duh. Tangerine Scream is the new signature colour for the Focus ST. The car is also available in Spirit Blue, Race Red, Black, White and Silver.

for performance cars at Ford Europe, says they went to a great deal of trouble to tune the "soundtrack" emanating from the engine, exhaust and intake system. To get there, they solicited feedback from a variety of people – organising clinics and introducing measurables – with the express intention of making the car deliver the right noises, both inside and outside the cabin, under hard acceleration. It worked: the sound is glorious.

Will the new Focus ST resonate with South African drivers? Yes. Will it stir their blood and shake up the hot hatch market? Damn right it will.

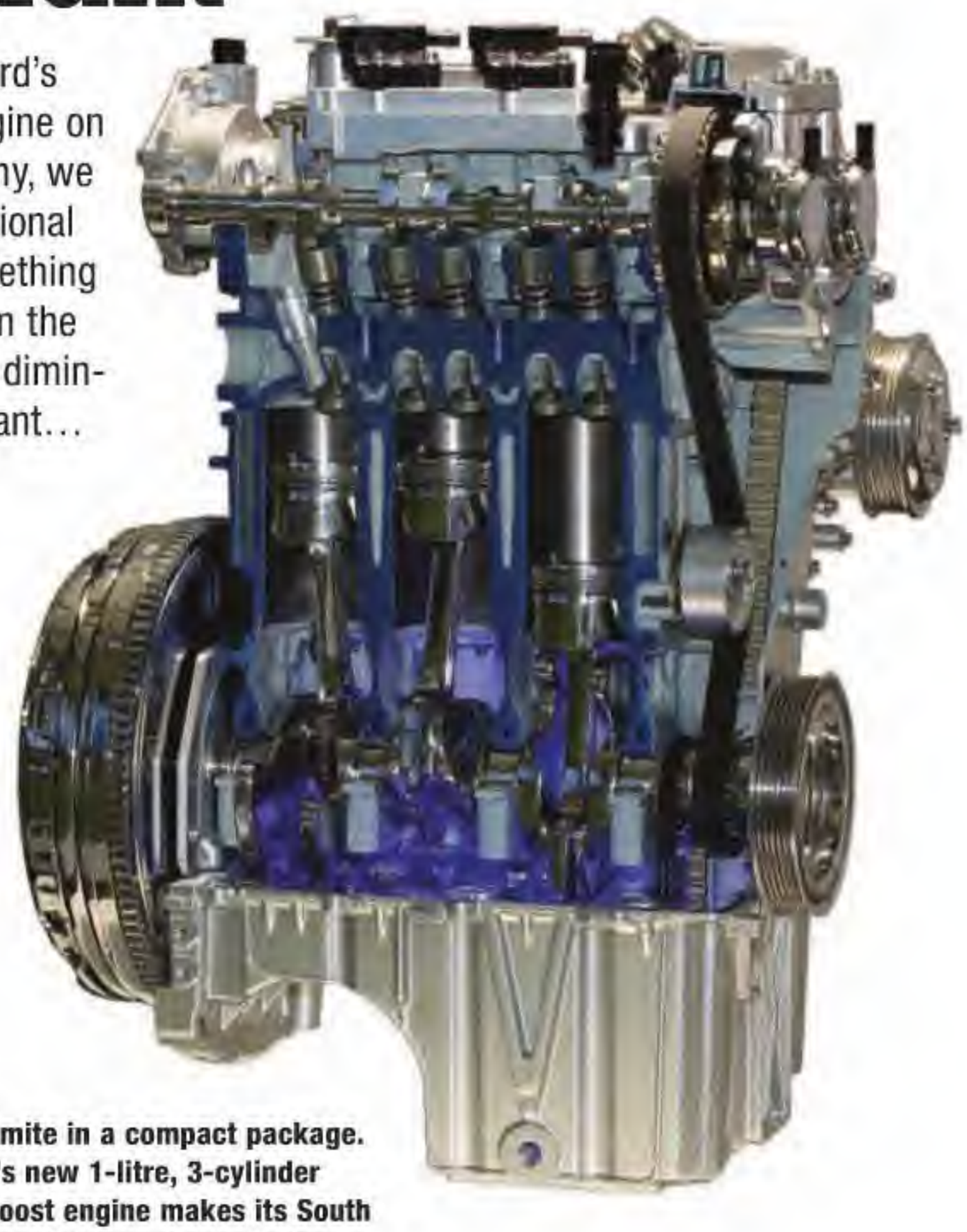
The Focus ST 5-door hatch will be launched in South Africa in November, to be followed "some time" next year by the Focus EcoSport, equipped with the 1-litre, 91 kW EcoBoost engine.

2013 Ford Focus Electric

What's new: Runs on electrons, thanks to a 105 kW electric motor and 23 kWh lithium-ion battery pack.
Neat trick: With a 240-volt 32-amp charger, re-energising the battery takes just four hours.
Driving character: Drives like the impressively refined and sprightly Focus, though a little lighter on the sprite.
Roadblock: Like all EVs, trip planning is critical. The range is about 120 km.
Possible alternative: A more affordable Focus that can refuel in under 5 minutes and go 640 km on a tank.
Coming to SA?: Er... don't hold your breath.

Heart of a **giant**

By the time we got to experience Ford's game-changing 1-litre EcoBoost engine on the highways and byways of Germany, we already knew it had won an International Engine of the Year accolade, so something technically impressive was clearly on the cards. What we didn't expect was a diminutive machine with the heart of a giant...



Dynamite in a compact package. Ford's new 1-litre, 3-cylinder EcoBoost engine makes its South African debut next year in the Focus EcoSport. The extremely fast response of the turbocharger results in virtually no turbo lag, the engine producing peak torque of 170 N.m from 1 300 to 4 500 r/min in the 91 kW variant.

In determining the winner of the International Engine of the Year showdown, the judges consider such factors as drivability, performance, economy, refinement and the successful application of advanced engine technology. The 1-litre EcoBoost engine ended up receiving 28 per cent more points than its closest rival and the highest score of any engine in the history of the competition. Reinforcing this success, a Ford Focus powered by the same engine recently set 16 new world speed records over two days at the CERAM test circuit in Mortefontaine, France.

Okay, here's what makes it different and rather special. Developed at Ford's Dunton Technical Centre in the UK, it has three cylinders and displaces just 1 litre (the size of the average superbike engine). It's equipped with direct fuel injection, variable valve timing on both intake and exhaust, and a compact turbocharger with a tiny, low-inertia impeller that spins at a formidable 248 000 r/min, resulting in negligible turbo lag.

That's just for starters. An advanced split cooling system plus the use of a cast-iron block cuts the amount of warm-up energy required by as much as 50 per cent, thereby slightly reducing fuel consumption. The two glass-reinforced drive belts are immersed in oil to deliver a quieter, more efficient operation (we're told they will last for the lifetime of the engine).

Ford's engineers compensated for the three-cylinder configuration by deliberately unbalancing the flywheel and pulley rather than adding energy-draining balancer shafts. It works: the engine runs smoothly and revs freely, as we discovered on our test drive in and around the German city of Cologne. In fact, we were astonished by its get-up-and-go, which resembled that of a 1,6-litre engine at the very least, and we were more than satisfied with the flexibility and low-end torque.

Then there's the miserly fuel consumption: the 74 kW version delivers best-in-class fuel efficiency of 4,8 litres/100 km and CO_2 emissions of 109 g/km; its more powerful sibling gets pretty close to that number. Aside from performing sterling work in the Focus, the 1-litre – the fourth in Ford's family of EcoBoost engines – will provide fuel-efficient power for two other models in the company's European product range, the C-MAX and all-new B-MAX.

Interestingly, Ford of Europe plans to triple its annual production of vehicles equipped with EcoBoost engines to about 480 000 by 2015. The company expects more than 300 000 of those vehicles to be equipped with the 1-litre version. **PM**

ALL THAT LIES BETWEEN YOU AND BETTER PERFORMANCE IS A PIECE OF PAPER

Ever wondered what keeps your engine really clean? Champion air filters have a tightly packed special paper ribbed design that removes 98% of all air contaminants such as leaves, dust and dirt. So the next time you wonder how you can keep your engine cleaner, and ensure better performance and longer engine life, choose Champion air filters **We've got the dirt.**

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COMPILED BY SEAN WOODS *seanw@ramsaymedia.co.za*

← THIRST QUENCHER

Lugging vast quantities of water around with you when you're out hiking can unnecessarily add to your load. Instead, take SteriPen's latest portable water purifier, the Adventurer Opti, along with you instead. This pocket-sized device weighs a mere 103 grams, but don't let its diminutive dimensions fool you – its long-lasting UV lamp is capable of purifying half a litre of water in just 48 seconds (double that if you want a litre), and is designed to provide 8 000 treatments. The two CR123 batteries it uses are good for around 100 litres of the clean thirst-quenching stuff. The germicidal ultraviolet light destroys bacteria, viruses and protozoa such as *giardia* and *cryptosporidium* but, as it can't filter out particles from water, we suggest you strain everything first. As an extra bonus, its LED water sensor can be used as a torch when the purifier's not in use. Price: about R1 100. Visit *www.duesouth.co.za*

WINTER WARMER →

Jumping up and down on the spot while slapping your arms against your sides may warm you up, for a while – but let's face it, there's got to be a better way. The, erm, handy Hand Warmer is the obvious answer. About the size of a smartphone and weighing 272 grams, this not-so-cool gadget is said to keep you nice and toasty for up to 12 hours on a single 12 ml filling of lighter fuel. Its platinum-catalysed glass fibre burner produces a whopping amount of radiant heat without a flame, so you'll never set yourself on fire. Operating it is easy: remove the lid, light the burner, wait for the indicator bar to turn red (there's no flame, remember) and pop it back in its protective warming bag. Price: about R330 (lighter fluid not included). Contact Mantality on 011-462 5482 or visit *www.mantality.co.za*

BRING IT ON →

Nothing intimidates the opposition quite like a dirty great chunk of motorised steel fitted with heavy ordnance. So, if radio-controlled war games are your thing, best you get Tamiya's 1/16th scale US M51 Super Sherman tank (with full-option kit) on your side.

Its front-mounted gearbox contains two Type 380 motors that can operate together or individually to produce forward/reverse running and pivot turning. Metal torsion bars and suspension arms combine with wide tracks to absorb bumps and dips in the terrain smoothly and provide high manoeuvrability.

Striking sound effects accompany engine operations, turret rotation, gun barrel elevation and depression. The main gun features recoil effects and can be elevated, depressed and swung left and right. Plus, if you fit the optional Battle System, you can enjoy one-on-one or team tank battles with other Tamiya 1/16th scale R/C tanks. Price: about R10 500, plus another R1 000 or so for the 4-channel transmitter and battery. Visit *www.jeffreystein.co.za*

PRECISELY DOES IT ↑

Hobbyists wanting to incorporate precise detail into their projects need look no further than Dremel's new 3000 all-round multi-tool. Perfect for detailed tasks involving cutting, grinding, carving, polishing and engraving, it boasts a number of improvements over the previous model. Reduced vibration provides better control, and a better grip in all key gripping areas makes for more precise handling.

Other features include a variable speed control (10 000 to 33 000 r/min), a collet lock, hanger bail and replaceable brushes. Power has been increased to 130 watts, and the new version comers with the innovative EZ Twist Nose Cap for spanner-free accessory changes. Two kits are available: the 3000-15 kit costs about R650 and includes 15 accessories plus a smart zipper bag; the 3000-1/25 kit – comprising a flexshaft, 25 accessories (including EZ SpeedClic) and a compact carry case – costs about R850. Contact Dremel Power Tools on 011-651 9858 or visit *www.dremel.com*

LIGHT UP YOUR NIGHT ↓

Looking for a high-powered headlamp that can soak up whatever you throw at it? Black Diamond's Icon is a fully waterproof, professional-grade light that should see you through virtually any eventuality. It boasts a healthy 200-lumen output with multiple modes that let you customise your lighting needs. Its red LEDs preserve your night vision, and are activated without having to cycle through the white modes first. There's also a lock mode to prevent accidental battery drain when the Icon is in your pack. Powered by four AA batteries, on its high setting it'll illuminate up to 200 metres for 80 hours. And, when set on low, its burn time is in the region of 175 hours. There's also a 3-level power meter that shows the remaining battery life for a few seconds after you've switched it on. Price: about R750. Contact distributors Ram Mountaineering on 021-532 0549 or visit *www.rammountain.co.za*

SURFACE DETAIL

We decided years ago that Microsoft wasn't as evil as certain people made out, and in fact, occasionally turned out some pretty good work (we expect this statement to significantly elevate morale at the software giant's Redmond HQ). What we *really* like is its newly announced tablet, called Surface – a slim and impressively equipped device that's destined to shake up this hugely competitive market sector. However, much will depend on pricing; we're told only that it will be "competitive".

Microsoft makes the point that the Surface was conceived, designed and engineered entirely by its own employees, and based on what we've heard, it has done an excellent job. First up – a full-sized USB port and a 16:9 aspect ratio, the industry standard for HD. The tablet's casing is created using an approach called VaporMg (pronounced Vapor-Mag), a combination of material selection and process to mould metal and deposit particles that creates a finish like a luxury watch's. This has allowed the integration of a super-thin kickstand that lets you switch from active use to passive consumption, perhaps while watching a movie or using the HD front- or rear-facing video cameras.

You also get a 3 mm Touch Cover (available in a variety of cheerful colours) that uses a clever pressure-sensitive technology to sense key-strokes as gestures, enabling you to touch-type significantly faster than with an on-screen keyboard. The cover clicks into the Surface via a built-in magnetic connector, forming a natural spine similar to one you'd find on a book. Alternatively, you can click in a 5 mm-thick Type Cover that adds moving keys for a more traditional typing feel.

The Surface will be available in two versions, one running an ARM processor with Windows RT, and the other featuring a third-generation Intel Core processor with Windows 8 Pro. According to Microsoft, Surface for Windows RT will release with the general availability of Windows 8, and the Windows 8 Pro model will be available about 90 days later. Pricing and availability in South Africa have not yet been announced.

SHOOT LIKE THE PROS

Just because you're a newbie happy snapper doesn't mean you can't take great photos. Canon's new easy-to-use digital SLR, the EOS 650D, was designed with beginners in mind. Sure, you can get fancy with all the manual modes if you want, but you don't have to.

First off, it features two new shooting modes to help beginners look like pros. HDR Backlight Control tackles tricky, brightly backlit scenes by capturing three different exposures – under-, correctly, and over-exposed – and combines them into one HDR image displaying both highlight and shadow detail. Handheld Night Scene makes it easier to capture beautiful low-light evening shots with no tripod, rapidly shooting four different images before combining them into one detailed, blur-free picture.

You also get an 18 megapixel APS-C Hybrid CMOS sensor that can handle 5 fps continuous shooting, the ability to capture Full HD moves, 9-point wide-area autofocus and an integrated Speedlite transmitter. Price: about R9 500 for the starter kit bundle (including body and 18-55 mm lens). Contact Canon SA on 011-265 4900 or visit *www.canon.co.za*

HEY, GOOD LOOKING

Mecer's new All-In-One desktop PC is so classy that it would look more at home in your lounge than in your office (but hey, you can use it there too, if you really have to). Featuring Intel's third-generation Core i5-3450 processor, a 54,6 cm Full HD LED screen, 4 GB of RAM and a 500 GB hard disc drive, it is as comfortable with fast-paced action or dull spreadsheets. There's also a built-in Webcam. Oh yes, and its processor, OS, RAM and hard drive can be upgraded. Prices start at about R7 000. Contact Mustek on 011-237 1000 or visit *www.mustek.co.za*

LIGHT MY FIRE

Log fires may provide a special ambience, but as home heating solutions they lag way behind Piazzetta's Pellet Stoves. Their fully automated top-of-the-range P963, burning a local biomass fuel in the form of wood pellets (made from wood waste, sawdust and wood shavings), really delivers when it comes to evenly distributing heat throughout a room.

Here's how this Italian-made beauty works: hot air is forced out of its bottom vent and allowed to rise naturally. This warm air is then drawn into the top vent to be warmed again via the heat exchange cavity to ensure that the heat produced by the firebox is evenly distributed from floor to ceiling. A sensor automatically regulates the desired room temperature. It can be remotely turned on by cellphone, too.

One load of pellets provides a burn time of up to 27 hours. And, if you want, the stove can duct hot air to adjacent rooms in your home via 70 mm pipes installed in the floor, creating a fully fledged central heating system. Price: about R47 500. Contact Calore Fireplaces and Stoves on 021-425 4192 or visit *www.calore.co.za* **PM**

Last chance

to WIN a new Ford Focus

To subscribe for only R239 for 12 issues, or extend your annual subscription for just R215, plus enter the Ford Focus competition – simply contact us with this code: 12/08/SP/PM

How to subscribe:

This price offer is valid until 31 August 2012 and for South African subscribers only. **Rules:** The Ford Focus competition ends on 31 August 2012. Entrants must be contactable by telephone. The winner must be over 18 years and be in possession of a valid driver's licence. The prize is not transferable, nor can it be converted into cash.

+ SAVE with our 10th Anniversary Offer!

This is your last chance to enter the Ford Focus competition! Subscribe to Popular Mechanics for 12 issues and you stand to WIN a dynamic new Ford Focus Trend 1.6 worth R233 290, plus extras!

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- a RoadHawk DC-1 vehicle black box camera system (see **www.roadhawk.co.za**),
- a Parrot MKi9200 Bluetooth hands-free system from TruBlue (see **www.bluetoothcarkits.co.za**),
- an easy-to-mount, aerodynamic Thule Wingbar roof rack (see **www.thule.co.za**).

PLUS, we celebrate our 10th birthday this month, and we are marking the occasion by giving all subscribers to this offer R10 off each issue. That's a saving of R120 for the year! Existing Popular Mechanics subscribers will save an additional 10% on top of this, as a thank you from us for their loyalty!

The all-new Ford Focus combines dynamic exterior design with a driver-focused interior, featuring a cockpit-style layout and superior craftsmanship. With its striking front end, sleek profile and athletic stance, this Focus enjoys sporty and contemporary styling while maintaining the comfort and practicality characteristic of the Focus brand.

Maximising sustainability was a primary goal for the all-new Focus. In addition to minimising CO_2 emissions through high-efficiency powertrains, weight saving and improved aerodynamics, the new technologies ensure that the Focus represents a green and sustainable vehicle choice. This holistic approach addresses the entire life cycle of the vehicle, from eliminating allergenic substances from the interior to incorporating recycled and renewable materials.

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The prize vehicle will be in one of the standard Ford Focus colour trims. Employees of RamsayMedia, Ford, and their immediate families, their advertising agencies and public relations agencies may not enter. The judges' decision is final and no correspondence will be entered into.

facebook IS PEOPLE

On 25 May, as his brain-child company went public, Mark Zuckerberg's face filled the multi-storey video screen adorning the Times Square Reuters building, his image a grinning, pasty vision of triumph – little brother as Big Brother. In the 30 seconds after the bell rang at the NASDAQ exchange, more than 80 million shares were traded, and with the IPO (really the night before, when the underwriting banks bought the stock from Facebook), Zuckerberg made $25 billion (about R211 billion).

But he wasn't making any money off me. I joined Facebook in 2007, back when you still had to identify your school to become a member. Carefully curated pics were promptly uploaded to my profile, and soon I was scrutinising my future college classmates, accepting friend requests with bright-eyed, bushy-tailed pride. I was never really addicted to Facebook, but for several years I would log-on at least once daily, friend-ing old summer camp acquaintances and lustfully stalking sweet Laxers (look it up).

After a while, however, I found posting and viewing Spring break beach shots (cellulite airbrushed out, cleavage brushed in) vaguely vulgar. The entire site seemed to be based around a strange, self-branding tango of exhibitionism and voyeurism. Still, I maintained my account to keep in touch with friends, to make sure my little sister didn't post any photos she would live to regret, and to participate in the enduring who-looked-hot/not dialogue with my peers.

Initially, I was even excited by the sharp-shot targeted ads. "Ee-gadz! I do want to check out that conflict-free diamond tennis bracelet, I do want to support Prop 19 and I do want to invest in blue-light acne treatment!" I found myself cooing over and over again. But after a while, Facebook's apparent telepathy had me jittery. I was a 20-something, prep-school educated Californian with a hazily expressed penchant for all things acceptably unorthodox, and Mark Zuckerberg and his army of youthful-genius programmers had successfully pigeonholed me. I found myself fitting perfectly into the Facebook algorithm (or rather, it fitting perfectly into me), and no number of Grateful Dead dancing bear T-shirts could counterbalance it.

iStock Photo/Tuomas Kujansuu

> BY ELISE KNUTSEN

My attitude toward the site had already generally soured when I heard last February that Facebook was going public, but within a week of the news, I deactivated, permanently, and I'll tell you why.

Aside from Facebook's use of my clicking habits and social network connections to tailor ads, I had another unsettling realisation. Facebook is a service and a product to its users. But they pay nothing to use it, and there is no native revenue stream. The value of the company – its main asset, to itself and potential business partners – is the users themselves, and access to them and their information. What they were planning to sell shares of was me. It was you.

With 900 million users, and an initial R877 billion valuation, let's say each Facebook profile is worth about R840. Now, the relative worth of a profile of course varies, based on level of engagement and other factors, but for argument's sake, to Facebook, and now to its shareholding public, you are worth about as much as a matinee ticket to a Broadway play. But that's just one you. It's the collective YOU that really matters.

Of course, data gathering as a for-profit enterprise is not unique to Facebook. For instance, the other company of comparable size whose main product and asset is its users is Google. However, there is a key difference: Google is transitive, whereas Facebook is reflexive. In other words, Google and its data collection are outward moving, leading to other destinations on the Web, other resources. Facebook's project builds entirely on the sum of its users interactions with one another.

In this sense, Google could be likened to a librarian whose services we enlist in exchange for the concession that what books we ask for will be tracked. Facebook, on the other hand, is like a party that all your friends attend, but in order to attend yourself, you must agree to have all of your interactions recorded.

In this way, the data, the information, and ergo, the value of Facebook is internally generative: the more interactions, the more information, the more the collective YOU is worth. And the rate of addition to the data value is astonishing. According to Facebook's own numbers, more than 3 billion "likes" and comments are posted each day, along with the uploading of more than 300 million photos (per day!).

It's then either a post-modern joke or a Marxist irony (or both at once) that we are able to buy shares of us. But either way, I don't want you buying shares of me. (Add to this the further irony that before the ostensible public offering of Facebook's stock, the vast majority were spoken for by the big-ticket clients of the banks that underwrote the IPO. And of the shares that were available to retail outlets, those were distributed preferentially to clients with the biggest accounts. Poor? Join Facebook. Rich? Buy Facebook.)

In the days since the IPO, Facebook's stock slid below its

ON THE WEB > Like PM's Facebook Page at *www.facebook.com/PopularMechanicsSA*

iStock Photo/DNY59

offering price – and as of this writing, is under $27 a share – but the daily stock prices are not the point, at the moment. Even as Zuckerberg's personal fortune fluctuates in multibillion-dollar swings, his project is bigger.

Projected to have one billion users by year's end, the sheer size of the Facebook community makes it hard to grapple with. There are few commodities, aside from air and water, used by as many people. Only Coca-Cola and Microsoft, and maybe McDonald's, can claim comparable numbers. Fully half of all Internet users are on Facebook, and that's a lot of eyes on ads.

But display advertising has proven to be a limited source of cash, and Facebook is focusing revenue streams from other sources. As the company itself noted in its SEC filing, "In 2009, 2010 and 2011 and the first quarter of 2011 and 2012, advertising accounted for 98%, 95%, 85% and 82%, respectively, of our revenue." (The company also gets a growing proportion of its revenue from fees paid by third-party apps and plug-ins, including 12 per cent of overall revenue from Zynga alone, the company behind the popular game, *Farmville*.)

The solution to the diminishing ad business, it seems, is tied to making Facebook into what Zuckerberg has called an "identity layer" for the entire Web. That is to say that in his ideal version of the site (and world), everything you do on the Internet will be through Facebook, including online transactions.

This is ambitious, but given the size of its user base, and how thoroughly it is already ingrained in people's Internet habits, eminently achievable. Even a modest version of this would be a revenue juggernaut. If the company were to, say, realise a revenue rate of 1 cent a day per user, by taking a percentage of transactions from vendors, that would be roughly R80 million a day, or over R29 billion a year. And that seems to be on the very conservative end of the hopes.

Now, this is troublesome when the head of the company has, let's say, "innovative" ideas about privacy. In 2010, *Silicon Alley Insider* obtained instant message conversations from when Zuckerberg was still christening Facebook at Harvard, in which he refers to users who have voluntarily given over their personal information as "dumb f__ks". The bluster of a power-drunk 19-year old, maybe, but in 2010, tech blogger Nick Bilton tweeted an exchange he had with a Facebook staffer:

"Off record chat w/ Facebook employee. Me: How does Zuck feel about privacy? Response: (laughter) He doesn't believe in it," the tweet said.

And indeed, the company was recently hit with a R126 billion class action lawsuit from a group of users claiming the company violated the US Wiretap Act by tracking their Internet use after they had logged out of Facebook.

The fact is, the more information Facebook gathers about you, and the more ways it has to monetise that information, the more the company is worth. Zuckerberg wrote in his letter to investors, "Facebook was not originally created to be a company. It was built to accomplish a social mission – to make the world more open and connected." Even taking this at face value, it doesn't really matter any more. It is a company, and a publicly held one at that. And even though Zuckerberg has a controlling interest in Facebook, it now has to be accountable to stockholders. The tension between user privacy and monetising data in service of stock price is a real one – and seems unlikely to fall on the side of users.

I see congressional hearings in our future. And what did Mark Zuckerberg, whose personal fortune is now bigger than the GDP of Jamaica, offer to the legions of users, whose time and information have imbued Facebook with its vast value? "In the past eight years," he said magnanimously, "all of you out there have built the largest community in the history of the world. You've done amazing things that we never would have dreamed of and I can't wait to see what you're all going to do going forward. So on this special day, on behalf of everyone at Facebook, I just want to say to all the people out there who use Facebook and our products, thank you."

He's right, it's all us. Which is a sweet sentiment, though not as sweet as the billions we earned him.

Despite all this, I don't expect an exodus. A critical mass has been reached, and projections suggest the site will continue to grow in the foreseeable future. I am not fighting against Facebook; Facebook has already won. By next year, one-seventh of the world's population will have an account on the site. Facebook is not a bubble that can burst – it has become a reality unto itself.

Still, I'm enjoying life as a conscientious objector. I don't need or want a third-party to manage my personal relationships for profit.

• First published in the *New York Observer*. **PM**

iStock Photo/kizilkayaphotos

iStock Photo/paci77

The IDC Green Industries Unit is providing development finance to a number of industry projects that will reduce the nation's carbon output.

The unit supports the development – in line with government's objectives of a totally carbon-neutral country by 2050 – of green industries and solutions including wind farms, solar thermal energy, bio-ethanol fuels, photovoltaic electricity generation and waste management.

If you have the true entrepreneurial spirit and a project that can contribute to creating jobs and building South Africa's industrial capacity, visit **www.idc.co.za** to find out how the IDC can help you go green.

Turning ***renewable energy generation*** *into a breeze*

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CASTING CALL ➡

MAKE A ROCK-SOLID PLANTER OUT OF TINTED CONCRETE.

BY JOSEPH TRUINI

Concrete is just as useful and versatile today as it was when the Romans discovered how to make it 2 000 years ago. Early masons used the humble mix of cement, sand, stone and water to build impressive structures such as the Pantheon (AD 126), which is still in use as a house of worship. With its stout granite columns and massive concrete dome, the Pantheon gives new meaning to "built to last".

Today, we use concrete for everything from home foundations to kitchen counters. It's also a great material for making smaller items, such as the planter shown here. Super-sturdy but simple to build, it requires the construction of inner and outer wood forms to mould the finished product. Basic carpentry tools, a wheelbarrow and a 40 kg bag of concrete mix are all you need to do a job that would make a Roman proud.

"It's very satisfying to mix up a batch of concrete, pour it out, and then eagerly wait for it to harden into something brand-new." —J.T.

GLOSSARY

OCULUS

In architecture, the Latin word for "eye" describes circular windows, skylights and other openings, such as the hole in the top of the dome of the Pantheon in Rome. Specific to 17th-century Baroque architecture, oculus and oeil-de-boeuf (French for "bull's-eye") are used interchangeably.

Pictures by Reed Young

1 FORM AND CAST

Screw together the inner and outer forms. Coat the exterior of the inner form with glue, and cover the surface with aluminium foil. Do the same for the inside face of the outer form. Spray cooking oil on the foil surfaces.

Place the inner form, top-down, on the mounting board. Screw through the bottom of the board into the form's cross supports. Place the outer form over the inner one, and use angle brackets to secure the outer form to the mounting board.

Empty a 40 kg bag of pre-mixed concrete (ask for the kind made with river sand) into a wheelbarrow. Add about 150 g of buff (a sort of yellowish-brown) liquid cement colour to 4 litres of water in a bucket. Add the tinted water to the powdered concrete a couple of cups at a time until the mixture is malleable but not runny.

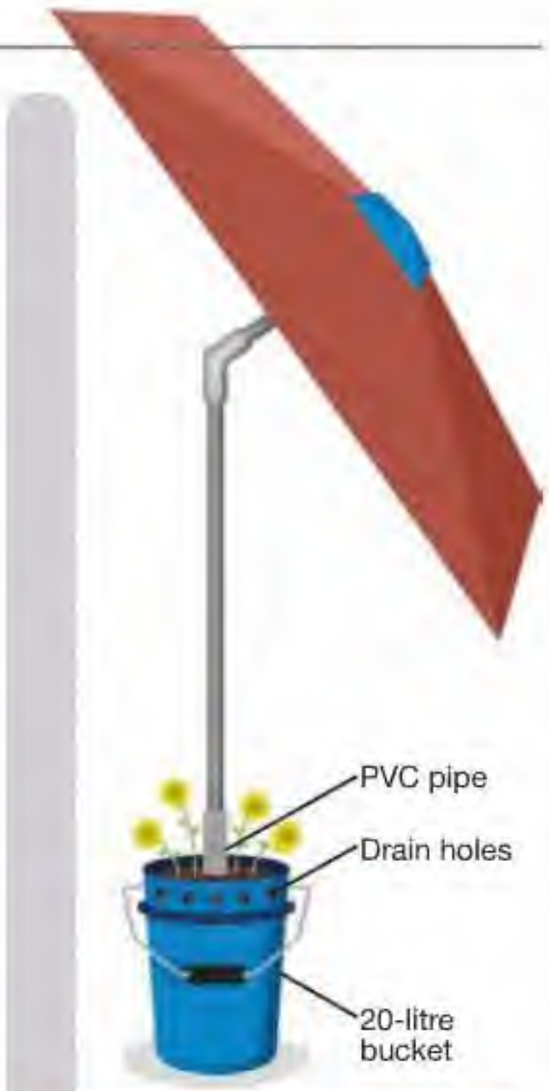
Pour the concrete into the form (left, top). Repeatedly plunge a scrap-wood stick into the concrete to consolidate it. Over-fill the form, then run an oscillating sander (without sandpaper) over the entire form to vibrate out voids. Strike off excess concrete. Form drain holes by pushing two dowels coated with petroleum jelly through the concrete.

2 STRIP THE OUTER FORM

After letting the concrete set for at least 18 hours, unscrew and disassemble the outer form (left, centre). Grab and twist out the dowels with pliers.

3 PULL THE INNER FORM

Remove the screws driven through the bottom of the mounting board and into the inner form. Tip the planter over and pull out the inner form (left, bottom). After the concrete has cured for 24 hours, apply a liberal coat of clear masonry sealer to the entire planter. Once the sealer cures, you're ready to plant! **PM**



THE RECYCLER

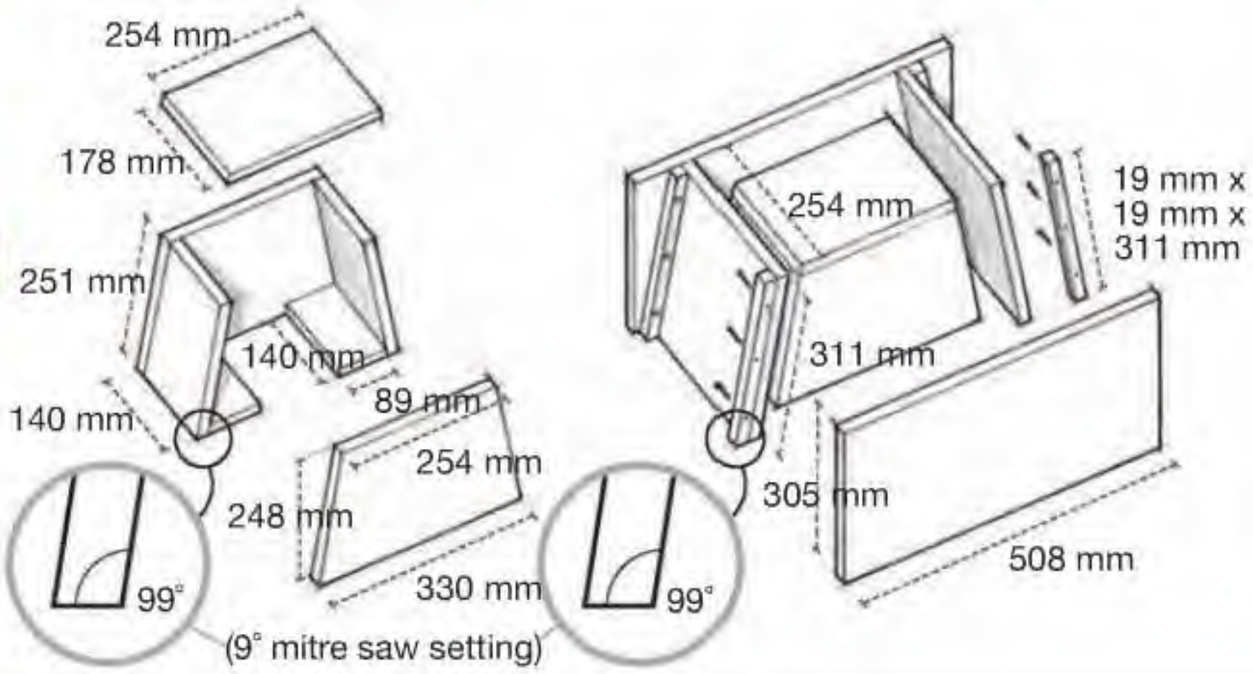
PATIO-UMBRELLA STAND

POPULAR MECHANICS READER TED ABT FOUND A GOOD USE FOR PVC PIPE AND A 20-LITRE PLASTIC BUCKET LEFT OVER FROM A REMODELLING JOB.

HOW TO MAKE IT

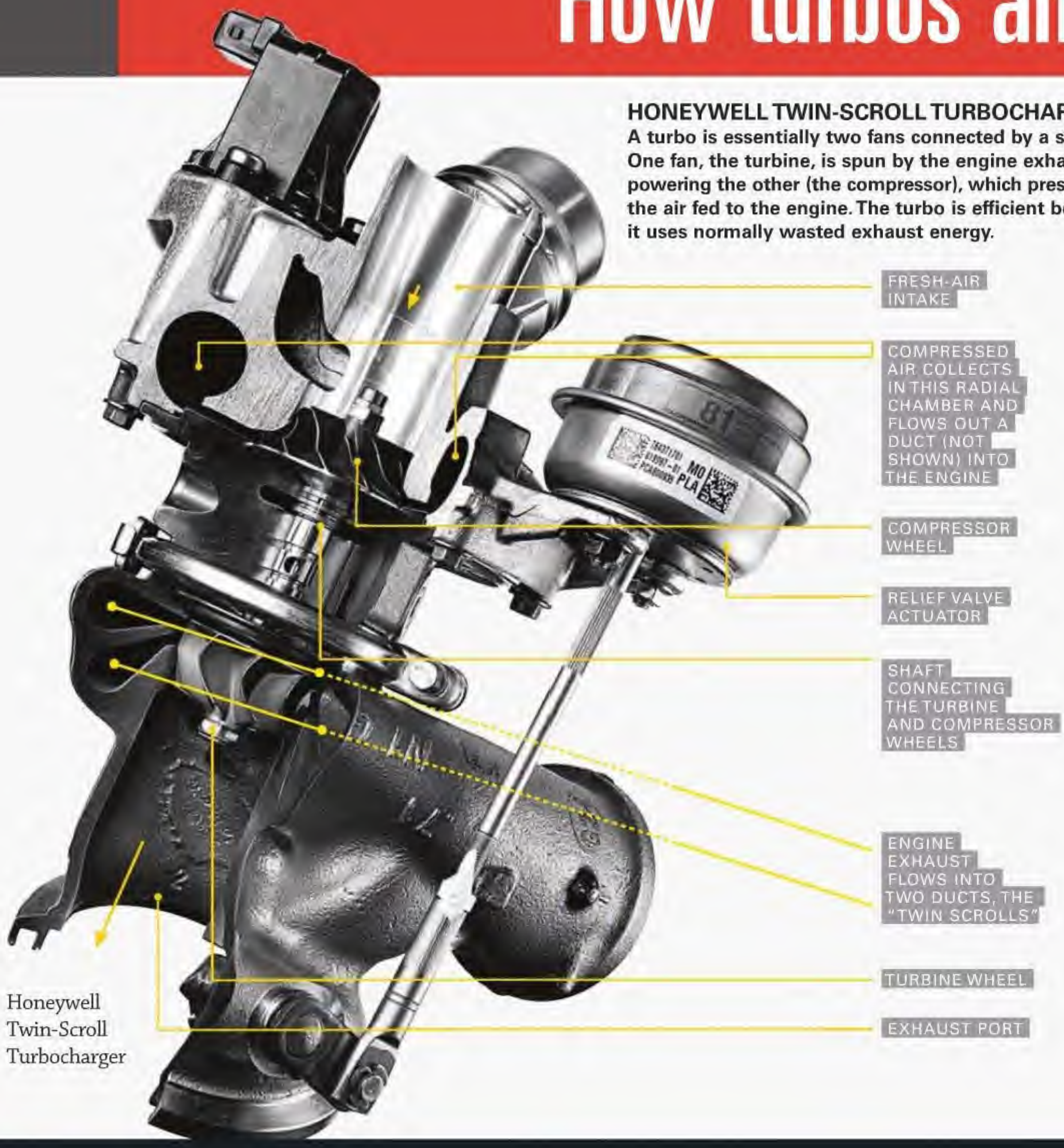
Dump most of a 40 kg bag of concrete into the bucket, add water, and mix. Use duct tape to seal one end of a piece of 40 mm PVC pipe, and push that end into the slurry. After the concrete sets, bore 5 mm drain holes through the bucket. Top the concrete with a layer of gravel covered with potting soil. Plant flowers, and insert a patio umbrella. Enjoy!

HOW TO BUILD THE FORMS



Illustrations by George Retseck (Planter plans), Barqvideo (umbrella Stand)

How turbos and



HONEYWELL TWIN-SCROLL TURBOCHARGER
A turbo is essentially two fans connected by a shaft. One fan, the turbine, is spun by the engine exhaust, powering the other (the compressor), which pressurises the air fed to the engine. The turbo is efficient because it uses normally wasted exhaust energy.

Honeywell
Twin-Scroll
Turbocharger

POWER PUMPS

To get both fuel economy and power, car manufacturers are boosting engines with pumps that provide extra kick when needed.

Big engines provide a satisfying surge, but most of the time we're using only a fraction of an engine's maximum power. To increase fuel economy, manufacturers are rapidly employing smaller engines – both in displacement and cylinder count. Downsized engines can, however, produce big-motor power with the help of pumps that force more air into the engine. The extra air, combined with fuel, makes a more powerful "boom" when the spark plugs fire, increasing power.

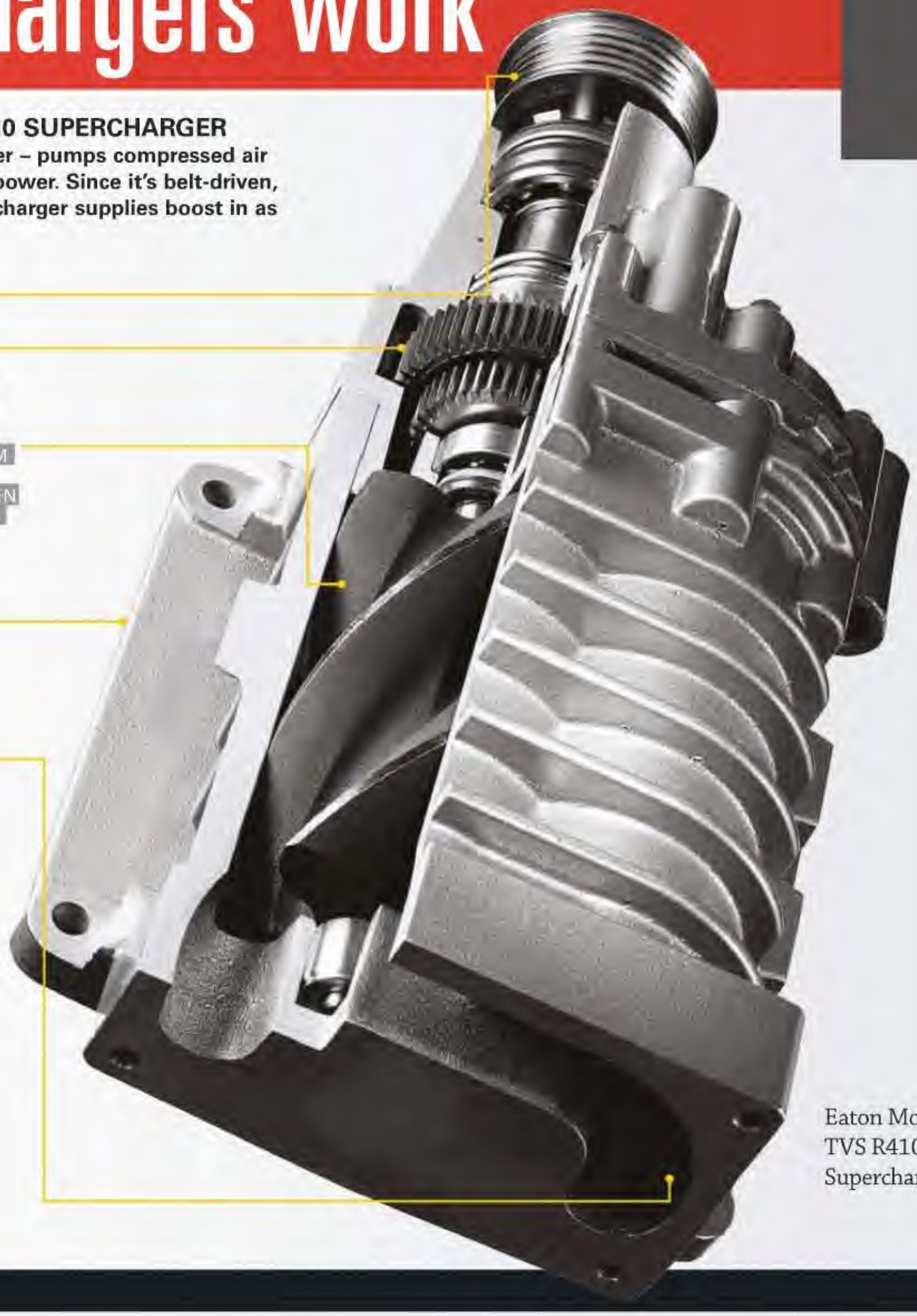
Automotive engine pumps come in two flavours: turbochargers and superchargers. Turbos are currently the de facto small-engine power

Pictures by Dan Saelinger

superchargers work

EATON MODEL TVS R410 SUPERCHARGER

The supercharger – or blower – pumps compressed air into the engine, increasing power. Since it's belt-driven, like an alternator, the supercharger supplies boost in as little as 250 milliseconds.



Eaton Model TVS R410 Supercharger

BY LARRY WEBSTER

booster because they efficiently run off the engine's exhaust. This energy may be "free", but there's a slight delay between the time the driver presses the accelerator pedal and when the turbo generates boost (the delay is known as turbo lag). While turbo-makers have reduced the lag with twin-scroll ducts that increase gas velocity, surviving in the over 1 000-degree exhaust requires exotic and expensive materials such as cast stainless steel and Inconel, a nickel-chromium alloy.

Superchargers have typically been employed when peak power – not saving fuel – is the ultimate goal. But refinements such as helical rotors and a bypass system for coasting have increased the blower's efficiency so that several manufacturers are keen to take advantage of the supercharger's relative simplicity and lower cost. Plus, a supercharger offers near instantaneous response, so a downsized, supercharged engine feels punchier in heavier vehicles such as SUVs. Compared with a nonboosted engine of equal power, a smaller "pumped" one is roughly 10 per cent thriftier, which is why the majority of new-car engines will almost certainly be boosted by the end of the decade. **PM**

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SO YOU WANT TO BUY AN...

ULTRA-BOOK

BY GLENN DERENE AND ANTHONY VERDUCCI

When Apple launched the wafer-thin MacBook Air in 2008, it seemed like an expensive, underpowered novelty. Now, superlight computers have hit performance parity with traditional laptops and prices have plummeted, with the rest of the PC industry hopping on the ultrabook bandwagon. What do you need to know before you buy? Let's look inside.

1 SCREEN The monitor determines the size and weight of the computer. To keep ultrabooks slim, manufacturers typically laminate LCD screens in place without a glossy protective top layer.

2 BATTERY Open an ultrabook and you'll see that half the real estate is occupied by a battery. These PCs can run 5 to 7 hours on a charge – accept nothing less.

This well-organised mess of electronic parts used to be a beautiful Samsung Series 9.

Pictures by Gregor Halenda

Diagrams by Lana Bragina

Know what you want

3 UNIBODY CHASSIS When you build something this thin, rigidity becomes an issue. Look for a firm metal (aluminium or magnesium) structure. Avoid plastic chassis, which can bend or break.

4 PORTS Prepare to make do with fewer of these. Ultrabooks have no optical drive and rarely more than two USBs (make sure at least one is USB 3.0), plus an SD card reader. At the 11-inch size, you often lose the SD, too.

5 WI-FI Unless you want to carry around a USB or proprietary Ethernet dongle, the built-in Wi-Fi card is your only path to the Internet – most ultrabooks have no built-in Ethernet jack.

6 CPU The ultrabook's secret ingredient is a low-power processor with integrated graphics. Newer PCs should be using Intel's Ivy Bridge CPUs, which stretch battery life and improve video performance.

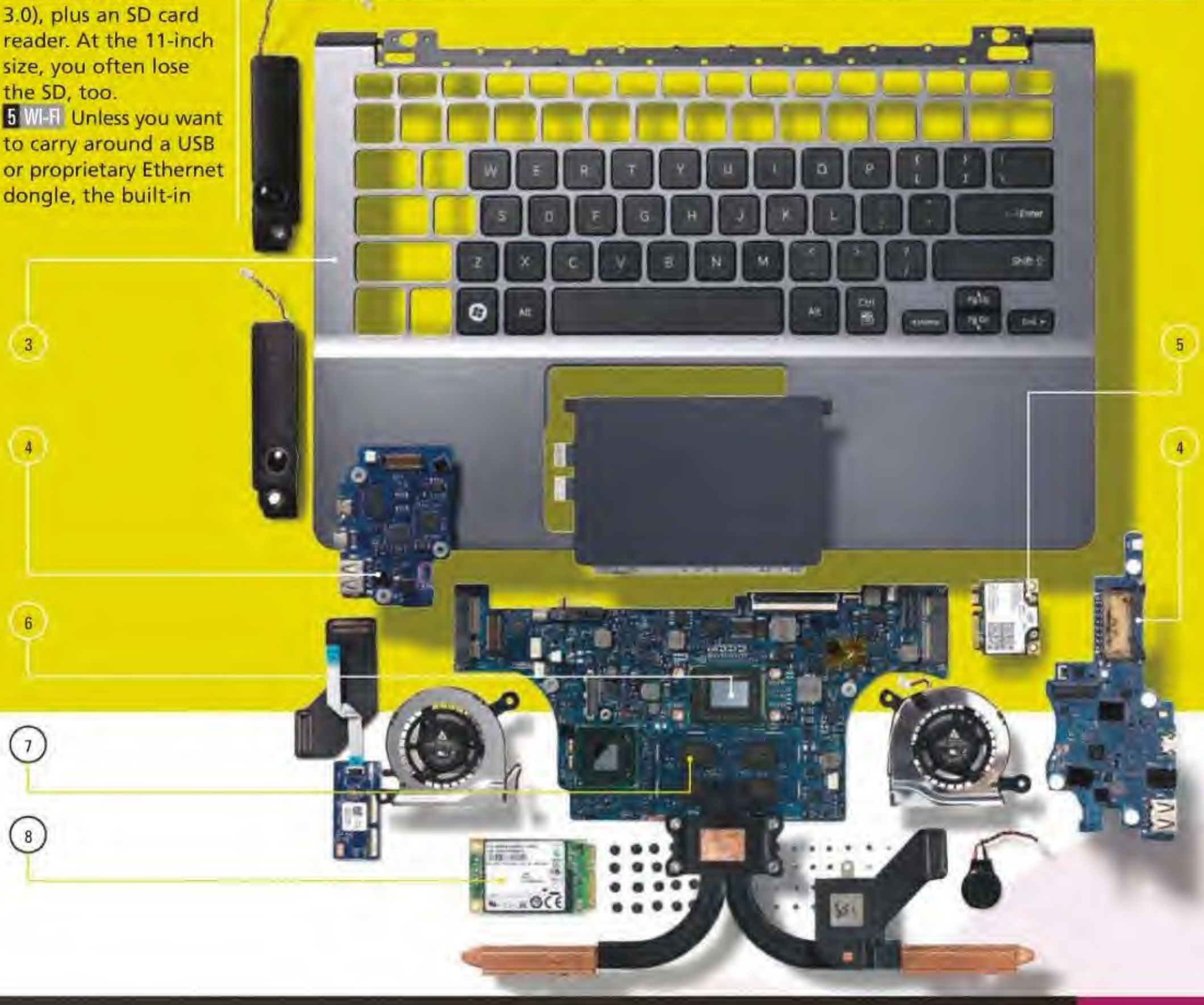
7 RAM In a typical computer, RAM is the most user-upgradable part. Not in ultrabooks. The RAM is soldered to the motherboard, so plan for the future by buying a machine with at least 4 GB.

8 HARD DRIVE Most ultrabooks use solid-state drives (SSD) in the new mSATA format – essentially, that's a small circuit board with flash memory on it. SSDs are speedy, but capacity is low. **PM**

INSIDE THE PM LAB

To take apart this ultrabook, we had to remove dozens of miniature screws. We counted 74 tiny 1,6 mm screws in the keyboard alone.

– Anthony Verducci



PROCESSOR

Intel i3	*Web surfing, music, photos, documents, movie watching*
Intel i5	*Video transcoding, light video and photo editing*
Intel i7	*Complex video editing, gaming*

HARD DRIVE CAPACITY

64 GB	128 GB	256 GB
13 000 MP3s	26 000 MP3s	52 000 MP3s
OR	OR	OR
16 000 pictures	33 000 pictures	66 000 pictures
OR	OR	OR
21 HD movies	43 HD movies	85 HD movies

DIGITAL CLINIC

> BY JOHN HERRMAN

POWER SHARING

I've got an iPad and an iPhone that share the same connector, but their power adapters have different wattage ratings. I travel a lot and would prefer not to take multiple adapters along. Can I use the higher-wattage adapter on both devices?

A Let's start with the official answer: Apple is totally cool with it – the company says so right on the product page for the 10-watt iPad USB power adapter. In fact, Apple lists compatibility with 23 iOS devices dating back to the first-generation iPod Nano. Also, we've tested it – nothing blows up, and the iPad adapter seems to charge the iPhone a bit faster than the stock iPhone charger. So you definitely can charge your iPhone with the iPad charger. The more interesting question, however, is, should you?

All iOS devices (and most smartphones) charge at 5 volts, the standard for USB devices. The difference between the iPhone and iPad adapters is the rated current – the iPad charger is rated to handle 2,1 amps, whereas the iPhone charger is rated for 1 amp. But the current rating is only a measure of the adapter's maximum capacity– the actual current is determined by the load (that is, the iPad or iPhone).

According to Steve Sandler, founder and chief technical officer of AEi Systems, an electronics analysis company, modern battery-powered electronics have a lot of complexity between the charger and the battery, including battery-charging circuits within the device and battery-protection circuits in the lithium-ion battery itself. These circuits are designed to manage the flow of electricity to the battery, and if the circuits inside the iPhone were designed to tolerate 1 amp, but are routinely exposed to 2 amps, that could stress the system over time. "Even though you may not immediately say, 'Wow, I just destroyed my battery!' you may limit its life over the long term," Sandler says, "but you wouldn't know for a year or more." Our advice: since Apple claims compatibility between the iPad charger and iPhone, pay for the extended two-year warranty for the iPhone to ride out your cell contract, and charge it however you like. If your battery degrades severely after the first year, make Apple give you a new one.

Apple iOS devices all use the same 30-pin connector, but the power adapters have different wattage ratings.

Picture by Ben Goldstein

WRISTS OF FURY

Q I work on a desktop with a mouse and my wrists are killing me. I'm thinking of changing to a laptop. Which is ergonomically better for your wrists, a trackpad or a mouse?

A Regardless of whether you're using a mouse or a trackpad, the first thing to consider when alleviating wrist pain is proper ergonomics. In fact, research has shown that products such as padded rests can actually increase the pressure on your wrist. So as motherly as it may sound, correct posture and how you hold your wrist when gripping a mouse or hovering over a trackpad is essential. Make sure your mouse or trackpad are at a comfortable distance (you're not straining to reach your computer or scrunched in too tight), and keep your wrist straight and off the desk, avoiding jerky motions by using your elbow as the pivot point. With ergonomics out of the way, back to your original question: mouse or trackpad?

Because they allow for more freedom of movement, trackpads are probably the better bet for reducing wrist pain. But Dr David Rempel, director of the ergonomics training programme at the University of California, Berkeley, admits that there hasn't been a definitive study on this topic. His own research on touch-screens suggests that touch interfaces

are more ergonomically kind, but they're also associated with slower input speeds. Depending on the nature of your work this might not matter.

Even if it does slow you down, Rempel suggests forcing yourself to switch occasionally to alleviate repetitive-stress injuries. (The stresses become less repetitive.) You might also try changing mouse/trackpad hands. It will be awkward at first, but spreading the load between hands also reduces pain – and the switch-up will be a good workout for your brain. **PM**

THREE APPS TO ORGANISE YOUR THOUGHTS

LEFT BRAIN ◄ ► RIGHT BRAIN

BENTO

Like its namesake, this app is all about compartmentalisation. Projects, calendars, car maintenance schedules, recipes, and more can be put into templated libraries for maximum organisation. Largely text-based, it functions like a personal card catalogue of things you need to get done. It's also a great way to handle inventory and expenses for a small business if you use it with the OSX desktop app. Bento is expensive for an iPad app, but it's still far cheaper than similar apps such as Things.

NOTABILITY

There are plenty of note-taking apps, but Notability is, er, notable for its free-form flexibility. It lets you draw or write on your iPad's screen with a virtual pen in multiple colours (many people choose to use a capacitive stylus for even greater precision). Notability also lets you import photos, diagrams, or Web pages into your virtual notepad and mark them up. Notes can then be exported as PDFs directly to a Dropbox account and automatically synced to multiple computers or shared with friends or co-workers.

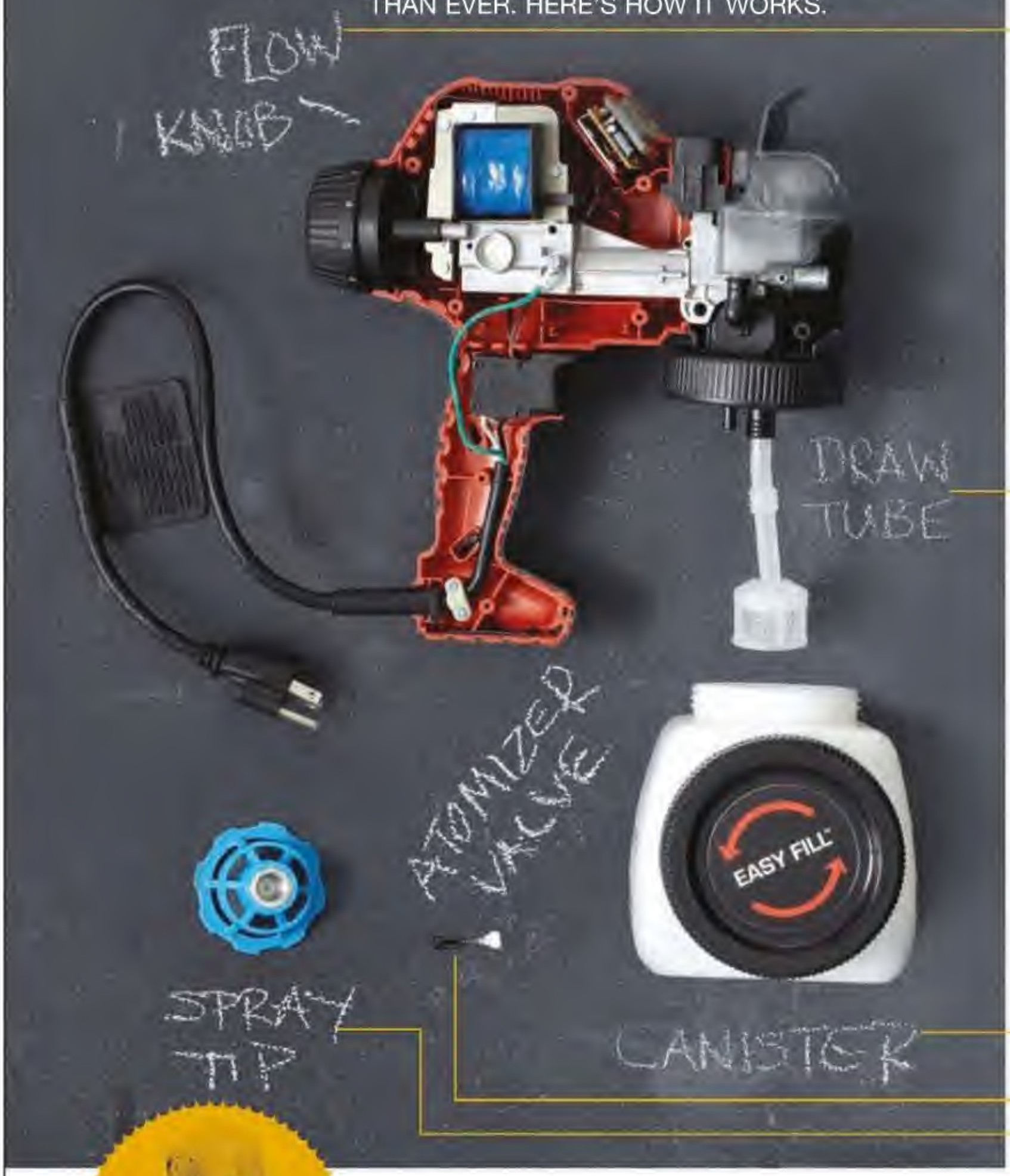
PAPER BY 53

Born from the ashes of Microsoft's scrapped Courier tablet project, Paper is an example of how restraint can increase the usefulness of an app. Paper's virtual brush-and-pen kit has only six tools and a nine-colour palette, and there's no way to drop in photos or zoom in on work. Yet for those who express themselves best visually, Paper can turn a quick sketch into a sophisticated piece of art. Plus, its undo function lets you dial backward in time. This program and a stylus will make an artist out of almost anyone.

HOW IT WORKS/**Paint sprayer**

TECH AND TOYS

BLACK & DECKER'S 2-SPEED QUICK CLEAN SPRAYER INTRODUCES TWO INNOVATIONS THAT MAKE PAINTING EVERYTHING FROM FENCES TO SHEDS QUICKER AND EASIER THAN EVER. HERE'S HOW IT WORKS.



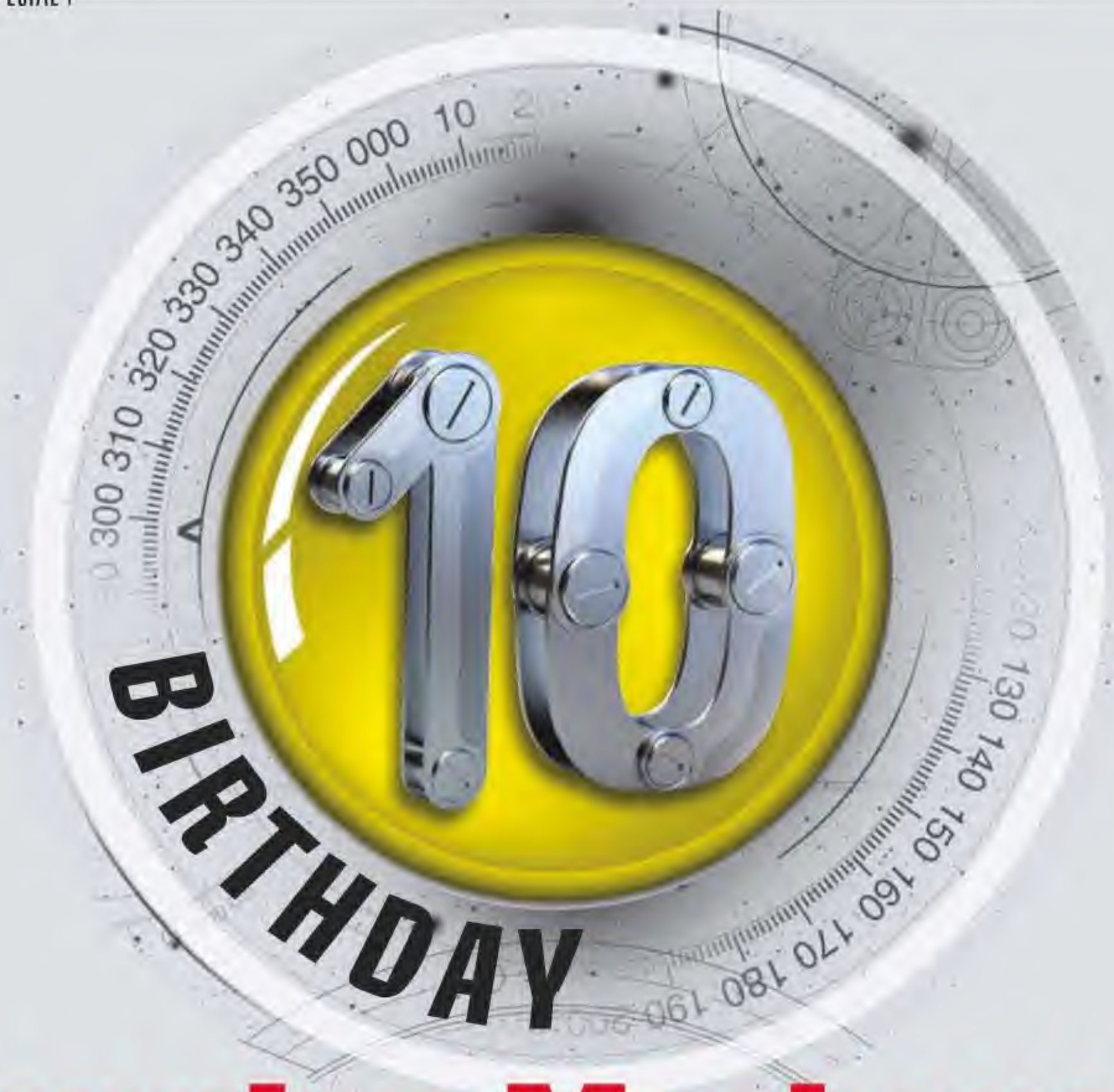
- Most sprayers require the operator to remove a canister and fill the reservoir from the top, which often leads to paint dripping from the draw tube and making a mess. Black & Decker's tool has a side-fill canister, which allows for quick, clean refilling.
- Set the flow knob to the desired intake – the higher the number, the greater the amount of paint sucked up and pushed out of the system – and switch on the machine; this kicks the solenoid motor into action.
- The motor drives a piston inside the sprayer at up to 7 200 pulses per minute, creating suction that pulls paint up through the draw tube.
- The paint travels past the piston to the atomiser valve, which moves in a swirl pattern to break up the paint for spraying.
- Finally, the paint moves through the spray tip – choose between horizontal, vertical and round spray patterns – and coats the surface.
- To clean the machine without taking it apart, simply pour water into the upper reservoir, flip the switch from paint to clean, and spray.

Photograph by Philip Friedman

PM'S ROY BERENDSOHN ON WHEN TO SPRAY IT AND WHEN TO BRUSH IT

Brushing is great in small spaces and on long narrow surfaces, such as trim or the corner where the wall meets the ceiling. A sprayer produces a high-quality finish – on kitchen cabinet doors or furniture, for instance – and is also a good choice for rough, weathered wood surfaces that can snag a brush or roller's fibres.

PM



Popular Mechanics

Ten years, a thousand experiences, a zillion excellent memories

We can put this quite simply: it's been an amazing ride, and from our perspective, we have barely started. In this special 21-page birthday section, we celebrate the completion of PM's first decade by recalling some of our most memorable covers (in some cases, they made their mark for unlikely reasons), highlighting important inventions from the past few hundred years (remember, we welcome debate) and unearthing some of the best devices from our ever-popular "Great Stuff" section – most of which will still resonate with gadget freaks.

In between, we unveil our planet's awesome beauty from a viewpoint in space, showcase an assortment of weirdly appealing DIY guitars and introduce a small sheep with identity issues.

As we move into our second decade, we thank you for your loyalty, for keeping us honest with your feedback, and for making us South Africa's leading science and technology title. We invite you to join us in the saddle – and if you thought the first lap was vigorous, be prepared to *really* muss your hair. – *THE EDITORS*

CONTENTS

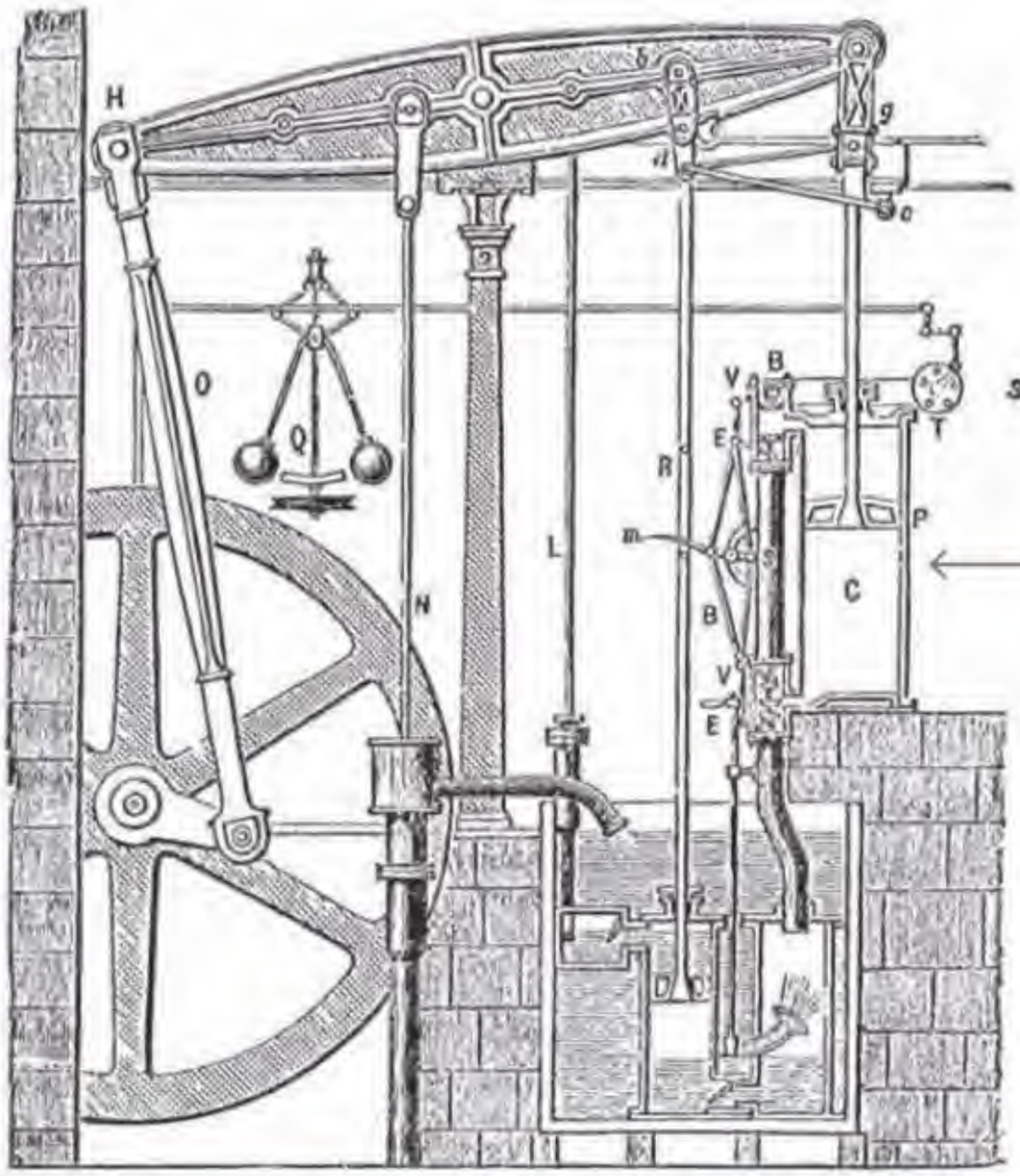
Top 10 **inventions**

A year ago, we published a cover story listing "100 gadgets that changed the world", featuring inventions ranging from the ridiculous (derringer, Super Soaker water gun) to the sublime (television, duct tape). In keeping with one of our prime directives – that is, we reserve the right to change our minds – we now have pleasure in presenting a smaller selection of inventions that may have escaped your notice – possibly because they are so familiar. Please feel free to engage us in debate...

Car Although some people might be inclined to argue, we'd say the world's first *proper* cars were the Benz Patent Motor Car and the Daimler Motor Carriage, both dating from 1886 (Daimler's Riding Car, which hit the road a year earlier, was the first vehicle to be powered by a high-speed internal combustion engine, and is probably best described as the world's first motorcycle.) Full disclosure: Frenchman Nicolas Cugnot's horrifically unwieldy three-wheeled *fardier à vapeur* ("steam dray") reportedly ran for the first time in 1769.

Printing press Invented by German goldsmith Johannes Gutenberg about 1440, this device and its successors played a hugely important role in the dissemination of knowledge (without the printing press, of course, you wouldn't be reading your favourite magazine). Gutenberg developed the entire printing process, adapting existing technologies where necessary and adding a number of his own, groundbreaking inventions. His hand mould, for example, permitted the rapid creation of metal movable type in large quantities. Within 60 years, Western Europe's printing presses had turned out over 20 million volumes.

Computer In 1823, Charles Babbage began working on his Difference Engine (he never finished the job, and it was completed by a Swedish inventor in 1854). In 1933, he switched his attention to the Analytical Engine, a general-purpose machine capable of performing difference functions based on programming (again, he never finished it). Which brings us to an interesting aside: Ada Byron (Lady Lovelace), the extremely clever daughter of poet Lord Byron, worked out a way for Babbage's machine to calculate Bernouilli numbers, effectively making her the world's first computer programmer. In 1939, a prototype of the first electronic computer was assembled by John Atansoff and Cliford Barry. Using 300 vacuum tubes, it was completed in 1942.



Steam engine

Although no single person can be credited with the invention of the steam engine, its first *recorded* appearance was in the form of the Aeolipile, described by Greek mathematician Hero of Alexandria (if you'd like to make one, look for instructions on the Web). Several rudimentary steam engines made their appearance during the following centuries, but the first practical steam-powered engine was developed by English engineer Thomas Savery in 1698. Thomas Newcomen's "atmospheric engine" followed 14 years later, and in 1720, Jacob Leupold built an efficient two-cylinder, high-pressure steam engine (described in his *Theatri Machinarum Hydraulicarum*). Probably the best-known contributor to the field was James Watt (1763–75), who improved on earlier designs (see picture above) and modified them to provide a rotary motion for driving factory mach-inery, at which point the Industrial Revolution *really* took off.

Harnessed electricity

Why "harnessed"? Because electricity has always existed; it's a natural phenomenon. Anyway, in spite of what you *think* you remember from your high school history lesson, Benjamin Franklin did not in fact invent electricity when he flew his kite in a thunderstorm. Much of the credit for generating electric current on a practical scale goes to English scientist Michael Faraday, who found that an electric current could be produced by motion in a magnetic field; he built a simple dynamo to show that it worked.

Many years later, prolific American inventor Thomas Edison came up with a practical direct current generator, establishing a company with British scientist Joseph Swan to manufacture filament lamps. However, it later became apparent that direct current (DC) had several disadvantages, and the work of brilliant men such as Nikola Tesla and American inventor George Westinghouse persuaded America (and the world) that alternating current – which allowed the transmission of higher voltages via transformers – was the way to go.

Transistor John Bardeen, Walter Brattain and William Shockley discovered the world-changing transistor effect and developed the first device in December 1947 while the three were members of the technical staff at Bell Laboratories in Murray Hill, New Jersey (they were awarded the Nobel Prize in physics nine years later). Developed as a replacement for bulky and inefficient vacuum tubes and mechanical relays, the transistor later revolutionised the entire electronics world, and today forms the fundamental building block of the circuitry in computers, cellphones and all modern electronics.

Flushing toilet A no-brainer: without it, people would walk around with pained expressions, no one would venture far from home, and civilisation would collapse. Although the ancient Romans had a crude version of it, and Englishman Thomas Crapper is widely credited for the invention, we should probably thank 16th-century writer Sir John Harington, who installed a working prototype in the palace of his godmother, Elizabeth I. The first patent for a flushing water closet was actually issued to Alexander Cummings in 1775.

Internet Whereas Tim Berners-Lee is credited with creating the World Wide Web, the Internet itself wasn't invented by anyone in particular. Wikipedia spells it out quite nicely: "(It) began with point-to-point communication between mainframe computers and terminals, expanded to point-to-point connections between computers, and then early research into packet switching. Packet switched networks such as ARPANET, Mark I at NPL in the UK, CYCLADES, Merit Network, Tymnet, and Telenet, were developed in the late 1960s and early 1970s using a variety of protocols. The ARPANET in particular led to the development of protocols for internetworking, where multiple separate networks could be joined together into a network of networks. In 1982, the Internet Protocol Suite (TCP/IP) was standardised and the concept of a world-wide network of fully interconnected TCP/IP networks called the Internet was introduced."

Corkscrew We're not prepared to debate the inclusion of this item. When did this utterly indispensable invention first make its appearance? Corkscrew historian Ron McLean, who runs the resource-rich Virtual Corkscrew Museum (*http://bit.ly/JhTpS*) has this to say: "The first corkscrews were derived from a gun worm, a tool with a single or double spiral end fitting used to clean musket barrels or to extract an unspent charge from the barrel." Wikipedia cites the *Treatise on Cider* by John Worlidge (1676), which describes "binning of tightly corked cider bottles on their sides", although the earliest reference to a corkscrew is apparently "steel worm used for the drawing of corks out of bottles" from 1681.

Lady Gaga New York-raised Stefani Joanne Angelina Germanotta (aka Lady Gaga) studied at the Convent of the Sacred Heart in upper Manhattan (where, as a matter of mild interest, PM editor Alan Duggan once heard a talk by sci-fi writer Isaac Asimov) and briefly attended New York University's Tisch School of the Arts before quitting to concentrate on her music – an inspired move, by all accounts. A flamboyant performer and deliciously weird dresser (she sparked outrage in 2010 when she turned up at the MTV Video Music Awards ceremony in a dress made from raw beef), she gives self-invention a good name. Visit her record label site for some cool videos: *http://bit.ly/LjVbeQ* **PM**

◆ O'DONOGHUE & ASSOCIATES 29783

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Lifting the COVERS

This (10th birthday) issue of PM is the 133rd to be published since our launch in August 2002. In that time, we have hotly debated the same number of covers and produced about 110 000 editorial pages – most of them, we hope, of compelling interest to our ever-growing audience. Here's a sample of covers that stood out for one reason or another…

AUGUST 2002

Our launch issue featured Sutherland's fabulous "giant eye" (the telescope known as SALT) as its cover story. The US edition had celebrated its centenary earlier the same year, and its former editor-in-chief, Joe Oldham, welcomed our magazine with these words: "Although its flavour is distinctly South African, the scope is universal and the focus ever sharp. It's how the world works." Exactly.

JUNE 2005

Arguably our favourite subject matter – what to expect from the future. Among the highlighted technologies: taking holidays in orbit (we moved a step closer with SpaceX's triumph a few months ago), nanoparticle cancer treatment, laser health diagnosis, metabolic pathways to healthy hearts, networked soldiers, cloned humans, and the growth of replacement body parts. In the same issue, we offered readers a chance to drive a Toyota Prius hybrid for a year and ran an interview with a bunch of South African rocketeers who were not afraid to think big.

OCTOBER 2004

Yes, it's a woman! As far as we could ascertain, this was the first time any edition of PM had featured the female of the species – and a rather fetching one, at that – as the hero(ine) on its cover. Although relentlessly demure bikini-clad women occasionally made an appearance on early covers of the US edition, they were usually presented as props (pun not intended) for sexy new powerboats.

APRIL 2005

This month's cover story, coming three years after the attacks of 9/11, was entirely appropriate. Despite masses of hard evidence to the contrary, conspiracy theorists everywhere – including nutters in this country – were trotting out all manner of spurious "evidence" to support their contention that the World Trade Centre and Pentagon attacks were the work of government spooks (one claim among many). We published a detailed refutation of their claims.

OCTOBER 2006

We asked our readers a simple question: "Are we alone?" One responded in the affirmative, saying he was indeed very lonely and asking whether we had a nice-looking sister to keep him company (smartass). However, the story was *actually* about the astonishingly resilient Earth-dwelling organisms known as extremophiles.

NOVEMBER 2008

Quintessential PM cover, reinforcing the can-do interests of our readers. Although some of the required skills were mildly tongue-in-cheek ("Recite a poem" and "Ask for directions" come to mind), the vast majority were relevant and useful. For safety's sake, we included a disclaimer to the effect that our female readers were constitutionally entitled to acquire whatever skills they chose.

FEBRUARY 2008

We argued about this one for days. Would a baby's face on our cover – those angelic features, those pursed lips – suggest that (gasp!) we were going soft – or worse still, prompt our readers to go "Aww..."? Would the skull cap and embedded electrodes introduce enough of a "tech" element to let us get away with it? In the event, there was little or no fallout, and legions of new mums failed to pick up the magazine.

JUNE 2008

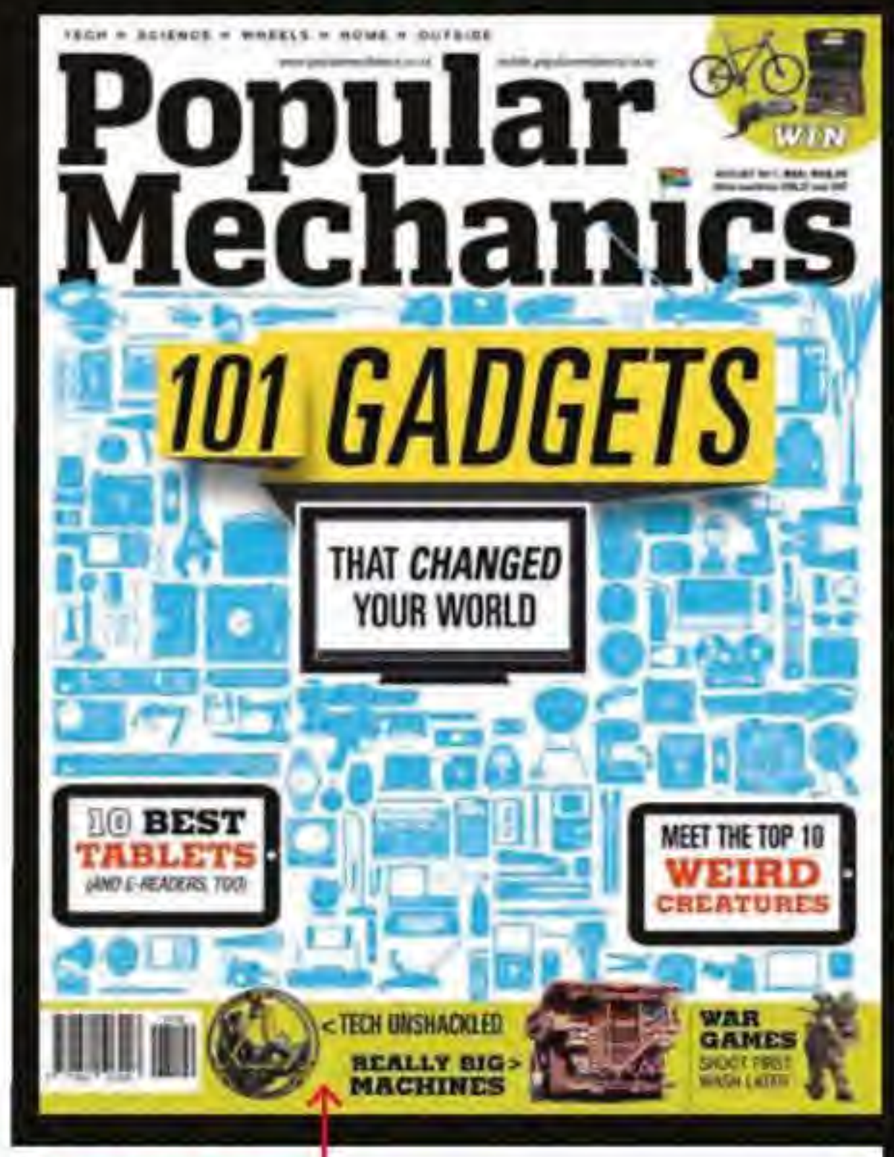
Our "porn" issue. Actually, it wasn't. The cover story was extracted from a quirky book by artificial intelligence guru Adam Levy titled *Love + Sex With Robots*, and it wasn't really salacious (that is, unless you were turned on by the idea of getting intimate with domestic appliances). Three subscribers cancelled, two more threatened to do so (but didn't), and the rest of our audience found it harmlessly weird or quite funny, including the editor's mother.

OCTOBER 2009

MythBusters Jamie Hyneman and Adam Savage were invited to contribute a major slice of this issue, which they did in their inimitable style – even having the temerity to mess with our 107-year-old (and usually sacrosanct) masthead. We lauded them as a fine example of the "can do, *will* do" attitude that we'd come to associate with our readers. Our inaugural 24-page "Clever Cars" supplement was published with this issue.

JANUARY 2012

Notable for its performance as the best-selling issue in our 10-year history, this one featured a striking white masthead and equally compelling mix of content, including an article by renowned South African cosmologist George Ellis.



AUGUST 2011

This cover resonated with our audience like few others. Although somewhat busy, it displayed a rich assortment of content teasers ranging from "101 gadgets" (gadget news remains among our most popular subjects) to a showcase of new tablets, a gallery of weird creatures, and machines that made red-blooded readers go "Yeah, baby!"

No place like HOME

Shortly before we went to press with this issue, we heard that the European Space Agency's Envisat Earth observation satellite was retiring after 10 magnificent years – double its planned mission lifetime. On these pages, we feature a very small sample of the formidably large collection of images captured by the eight-ton satellite – equipped with 10 sophisticated optical and radar instruments – in more than 50 000 orbits, together with images from ESA's so-called "Third Party" missions. Envisat has contributed immeasurably to our knowledge of Earth, its weather patterns, oceans, atmosphere, environmental challenges and myriad other processes.

An artist's concept of the European Space Agency's Envisat satellite in orbit. The largest Earth observation satellite ever built soared into orbit from ESA's launch base in Kourou, French Guiana, in March 2002. Two years later, the mission's first scientific results were presented at the Envisat Symposium in Salzburg.

IMAGES > Visit *www.popularmechanics.co.za* to download wallpaper images captured by ESO's Envisat Earth observation satellite.

< A radar image captures the Western Cape, with the curved Peninsula jutting into the Atlantic Ocean. This image was created by combining three Envisat Advanced Synthetic Aperture Radar acquisitions (3 June 2010, 29 April 2010 and 25 March 2010) taken over the same area. The colours in the image result from changes in the surface that occurred between acquisitions.

< The sandy and rocky terrain of the Sahara desert in western Algeria. With the Mediterranean Sea almost 500 km away, the closest town to the area pictured here is Taghit in the Algerian province of Béchar. The commercial Ikonos-2 satellite acquired this image on 23 April 2008 at a spatial resolution of 4 metres.

∧ This Landsat image of 3 October 2011 shows the Mississippi River Delta, where the largest river in the US empties into the Gulf of Mexico. In this false-colour image, land vegetation appears pink, while the sediment in the surrounding waters is coloured bright blue and green.

∧ Iran's Qeshm Island, the largest island in the Persian Gulf, lying just a few kilometres off the Iranian coast near the narrow Strait of Hormuz, which separates the Persian Gulf to the west and the Gulf of Oman to the southeast. Qeshm Island harbours the Hara Biosphere Reserve, the largest stretch of mangrove forest along the Persian Gulf shoreline. This network of shallow waterways and forest can be clearly seen in the image, between Qeshm Island and the mainland.

A spring bloom of phytoplankton is captured in this image off of Ireland's northwest coast in the North Atlantic Ocean. In the lower-right corner, we can see part of County Mayo's coast – which appears pink in the false-colour image. Broadhaven Bay, with its opening facing north, is also visible.

Australia's Great Barrier Reef off the coast of Queensland is the world's most protected marine area – one of its natural wonders and a World Heritage site. Spanning more than 2 000 km and covering an area of some 350 000 km², it is the largest living structure on Earth and the only one visible from space. This image was acquired by Envisat's Medium Resolution Imaging Spectrometer (MERIS) at a resolution of 300 metres.

A composite radar image showing Salt Lake City and the nearby Great Salt Lake in the US state of Utah. The line running across the lake is the Lucin Cutoff railway; the causeway supporting the line divides the lake and prevents the normal mixing of waters. The lower-left portion of the image shows Salt Lake City with marshlands and mudflats separating it from the water.

V Holbox Island and the Yalahau Lagoon on the northeast corner of Mexico's Yucatan Peninsula are featured in this image, acquired by the Korea Multi-purpose Satellite (Kompsat-2) of the Korea Aerospace Research Institute (KARI). ESA supports the Kompsat series as a Third Party Mission.

A A terrible beauty. The extraordinary landscape of the Tanezrouft Basin, one of the most desolate parts of the Sahara desert, in south-central Algeria. The region is known as "land of terror" because of its lack of water and vegetation. This region is characterised by dark sandstone hills, steep canyon walls, salt flats (white), stone plateaus, sandstone outcrop patterns of concentric loops, and sprawling seas of multi-storey sand dunes known as "ergs". Erg Mehedjibat, which appears as a bouquet of yellow flowers (upper right), is made up of a cluster of small star dunes that grow upwards rather than laterally. Japan's ALOS (Advanced Land Observing Satellite) captured this image in 2009.

10 YEARS OF SERIOUSLY COOL STUFF

PM's **GREAT STUFF** *pages have featured an extraordinary variety of gadgets over the years, introducing readers to everything from desirable consumer electronics to essential camping gear, from high-tech toys to weird items that defied categorisation (but that we really, really wanted). Here's a selection of items that captured our attention during the past decade...*

Data in your pocket

It was 2003, and we were very excited about this USB flash drive from Lexar Media, with its eye-watering 128 MB capacity and giveaway price of R1 140. That's megabytes, people. To put this into perspective, we've just bought a 32 GB flash drive from an online merchant for around R200 – that's about one-sixth the price for 250 times the capacity of the 2003 device.

Who needs two wheels, anyway?

Voted Best New Product at the International Cycling Exhibition in London, the KMX Kart was a trick machine designed for kids aged 7 to 14 years. This nifty recumbent three-wheeler featured Ackerman centre point steering and 5-speed derailleur gears.

Serious muscle

Aimed at hands-on home builders who didn't believe in getting all hot and sweaty, the Dingo K9-4 Mini Digger from DingoworX was sold with 64 different attachments that allowed it to dig ditches, drill holes for posts, mix cement, lift blocks, breaks rocks, and more. It sold for around R190 000, and we really liked it.

Vamp it up

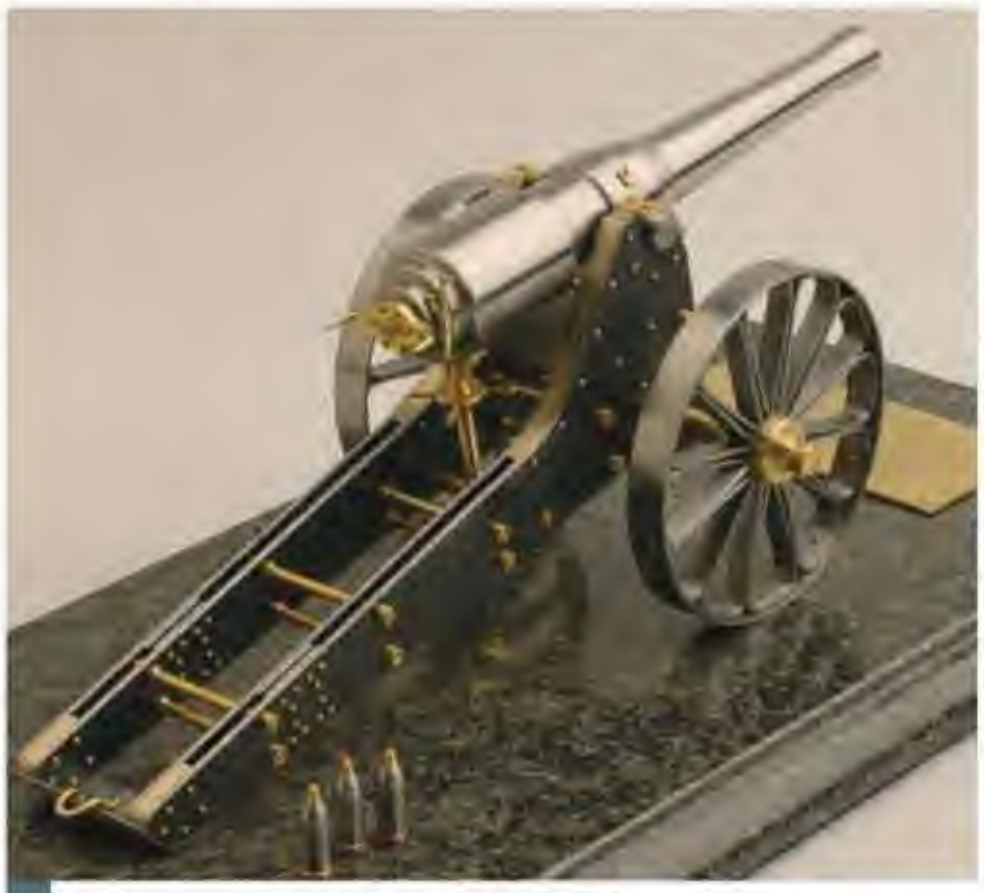
We had a lot of fun with this gadget, flying it around the office and scaring unsuspecting colleagues with its realistically flapping wings and glowing red LED eyes. Technically, it was a radio-controlled ornithopter; in practice, it became a scary vampire bat in pursuit of fresh blood.

Starry, starry night

Sky-Watcher's ED PRO Apochromatic refractor telescope, equipped with full GoTo functionality, was among the sexiest and most efficient we could find, although the price was a little steep: it started at R16 500 and went up to R25 000 (for the 120 mm model).

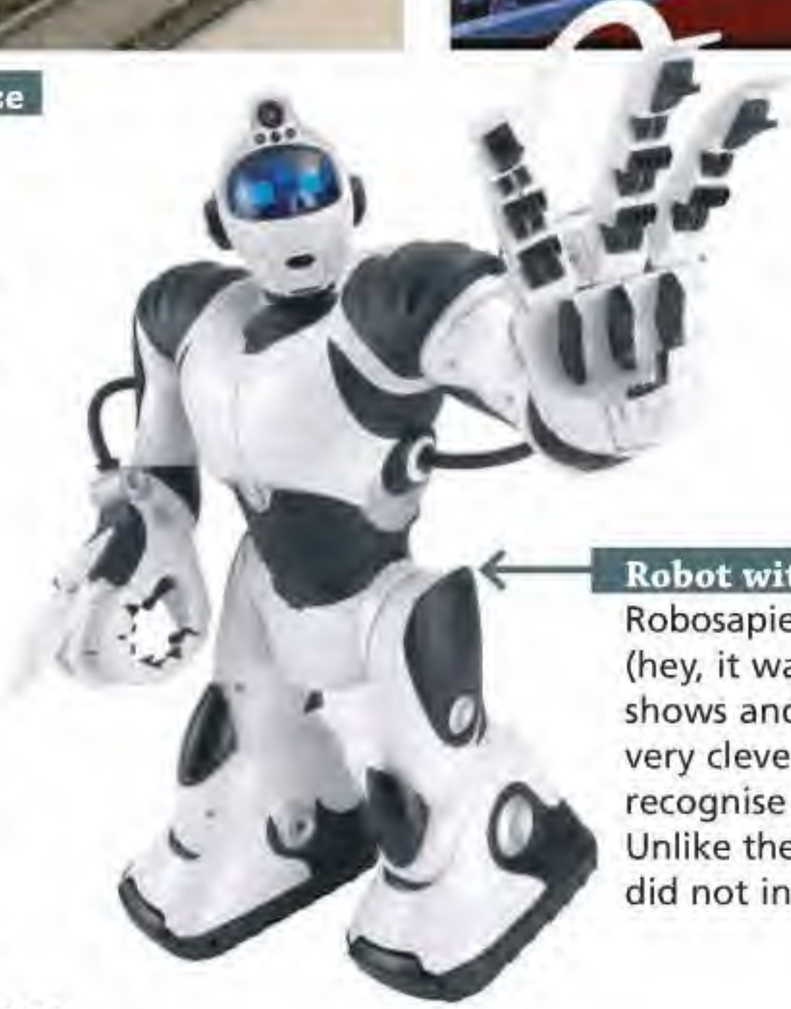
Ride anytime, anywhere

Part skateboard, part snowboard and part bicycle, the mountain board featured an adjustable steering system, rugged pneumatic tyres, a handheld V-brake, and foot straps. Prices for these rugged devices ranged from R1 600 to R5 400.



Own a cannon, start a craze

This beautifully detailed, hand-built replica of Long Cecil, the cannon that became famous during the Siege of Kimberley, was showcased in our very first issue (August 2002). Weighing a formidable 8 kg, the 1:16 scale model featured a 19 cm steel barrel. Ten years on, its creator, Port Elizabeth's Zane Palmer, is still turning out some amazing models (that is, when he can find the time). If you'd like to get in touch, call him on 083 261 6513 or e-mail *zanepalmer@telkomsa.net*.



Sideshow

At the time, we wondered why no one else had thought of this. The portable, collapsible paddling device was called JetBlade, and it equipped leisure boaters to paddle with their feet, leaving their hands free for more important stuff (you know, fishing and drinking beer).

Robot with attitude

Robosapien 2 was the second robot we'd bought for ourselves (hey, it was for *research*), and we made it work for us at shows and promotions wherever we went. It was capable of very clever stuff, including the ability to track movement and recognise objects; it even extended its hand for a shake. Unlike the original Robosapien, however, its wake-up routine did not include an endearing fart. **PM**

Extreme guitars

DIY creations that push the boundaries

> BY LAURA KINIRY

Wannabe songwriters and rock stars alike ply their trade on an instrument whose basic design has barely changed in centuries. The essential guitar layout is familiar and straightforward: curvy body, long neck, six strings… that more or less sums it up. Creative luthiers have seldom strayed far from this template; generally, they've found electric instruments (which don't need an acoustic "soundbox") more suitable for way-out designs such as Gibson's Flying V.

But, for some extreme strummers and pickers, that's not enough. The instruments you see on these pages do more than play music – they push the boundaries, resulting in amazing instruments that need to be heard and seen.

Saving the rhino

One of several first-rate South African luthiers, Murray Kuun handbuilds a range of instruments from acoustic guitars to electric guitars (see left) – even violins. He is currently busy on the Big 5 collection, and has to date completed the Leopard and the Rhino – the latter being 100 per cent made out of African materials. His Elemental bass is made of imbuia and sapele; other models such as the Modena and Dino (do we detect a fondness for Ferrari sports cars?) make use of traditional guitar woods such as birds-eye and curly maple as well as unconventional woods such as mahogany.

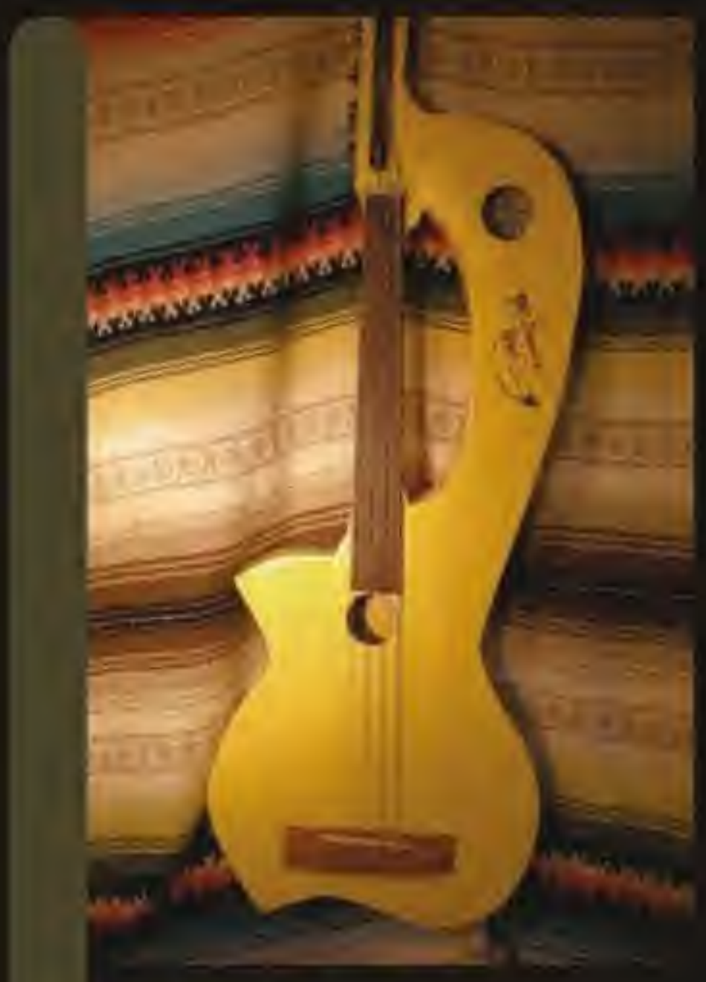
Kuun is also highlighting his environmental sensibilities with his Rhino, which he describes as similar in general concept to pre-war, Depression-era guitars built by some famous high-end guitar companies. "The body and neck construction is (unusually) all-mahogany; the hallmark of this type of guitar is a beautifully rich, but precise sound. This guitar is no different, it sounds gorgeous." A portion of the proceeds of the guitar's sales will go towards the fight to save the rhino.

< Pikasso

When jazz guitarist and composer Pat Metheny asked luthier Linda Manzer to build a guitar with "as many strings as possible", the work took two full years. The result: the Pikasso Guitar.

This 42-string instrument (all of them are playable) is an obvious ode to the Spanish artist for whom it's named. Manzer's own masterpiece includes ebony fingerboards, bridges and face plates; two sound holes; and two access doors into the guitar's interior for repairs or amplification. One of the instrument's most innovative features is "The Wedge", a tapered body shape that makes the side closest to its player thinner than the opposite side resting on the player's knee. The Wedge also increases underarm comfort for the musician and provides a better aerial view of the strings: the guitar leans inward towards the guitarist rather than being parallel to the player's body.

Along with its avant-garde design, Manzer's award-winning Pikasso employs a state-of-the-art piezo pickup system with a hexaphonic pickup on the six string section. This allows Metheny to access his Syclavier computer system and trigger any sound, including sampled sounds.



Banana Bass

Steve Wishnevsky's Banana Bass gets its name from its tropical yellow exterior, which he says was the serendipitous result of grabbing the first can of paint he could find. The left-handed fretless instrument features a solid wood neck and a hollow body made of 3 mm Baltic birch plywood, so the bass is both light and strong. Its softer sound is most useful for recording and acoustic jam sessions.

Villainizer X3

To make his steampunk-style instrument, Jeff Ritzmann first disassembled a Jackson Randy Rhoads guitar, sanded it down and cut its upper wing to elongate the design. He then screwed a "gearbox" into the guitar's body and added equidistant screw cap covers around the edge as rivets before texture-painting the entire thing using faux hammered-metal techniques. Ritzmann later filled the gearbox with real metal gears that he cut and then mounted (using steel brads) at varying heights, overlapping to cause a dimensional optical illusion. The gears are just for show, though. Ritzmann says that they'd interfere with the guitar's sound if they actually moved.

After adding the jack wire – which Ritzmann disguised as a tube – he rust-outfitted the entire instrument by hand, using a combined paint and chemical process. Copper Tesla coils and copper fittings were added last, creating a wicked guitar that's built like a tank and only looks heavy. In truth, it's the guitar's sustain that's beefed up.

Villanizer X3 photos by Donna Feldman Lasky, *www.shootbare.com*

VIDEO > Visit *www.popularmechanics.co.za* to watch a video showing the awesome Jimi Hendrix tribute guitar.

Ultrazone

Alistair Hay of Ireland's Emerald Guitars built the UltraZone Guitar (below) for musician Steve Vai, whose music changed his life. The guitar is a fully functioning replica of the illustrated axe seen cradled in the arms of an alien on the cover of Vai's 1999 album *The Ultra Zone*, and has its own pod-like case.

Hay carved his six-string from a block of rigid urethane foam using only a Dremel multitool and sandpaper. He then covered it with carbon fibre, employing a wet layup process to create a strong exoskeleton, and spliced the guitar's wood neck and body centre (where the pickups are located) into the carbon foam body, giving it a carbon skin.

The entire instrument has an outer finish of colour-shifting Triflash paint, adding to its biomechanical look. Exterior add-ons come from repurposed extras around Hay's shop, including copper brake pipe and electric wire that he wrapped around the headstock. Hay also fashioned the Alien (right and far right).

Top Guns

Villainizer creator Ritzmann also did a guitar for the internationally known artist T-Pain for his album *rEVOLVEr*. The design includes a working revolver chamber and bullet feed. Further exploring the theme, he has created the Gunslinger bass.

Right now he's working on his next model, called Titanic. And yes, it will be a guitar based on the ill-fated vessel and is timed to coincide with the 100th anniversary of its maiden voyage.

MF2

Doron Markowitz's stellar Millennium Falcon guitar is not a toy guitar, but rather a guitar built from a toy. The base of this hyperspace rocker is Hasbro's 1995 Light and Sound Edition Millennium Falcon, complete with the toy's built-in special effects. Four different sounds and lights are wired up to a special volume control that powers through the amps, allowing the musician playing it to rock laser blasts along with guitar riffs.

All the design elements reflect *Star Wars*' themes: The tone knob features the Jedi council insignia; the guitar's camouflage strap is straight from the uniforms of rebel forces that landed on the moon of Endor in *Return of the Jedi*; and Han Solo and Chewy action figures are even sitting in the Falcon's cockpit.

– Additional reporting by Anthony Doman **PM**

www.peugeotwebstore.co.za

In addition to being fuel efficient, the 208 is among the greenest in its segment, emitting as little as 104 g/km CO_2 and helping those who drive it to keep their personal carbon footprint low.

An eye-level instrument panel; a smaller, sportier steering wheel; and more room contribute towards making the 208's interior a universe of fulfillment where everything is intuitively in just the right place.

At 110 kilograms lighter than its predecessor across the range, the 208 boasts an improved power-to-weight ratio that gives it exhilarating performance, economic fuel consumption and more responsive handling.

A music station complete with USB and Bluetooth technology, standard across the 208 range, completes the digital integration of the 208's interior.

JET YOUR BODY DRIVE

DRIVING REINVENTED

So far, the enigmatic Peugeot 2 series has enjoyed three memorable decades of success. The 208 does more than build on this triumphant lineage – it reinvents it in terms of style, technology and structure. The 208's cabin is a motoring ergonomic breakthrough and its exterior is sculpted and athletic with a powerful sophistication.

Greener, more efficient and more beautiful – there's no better time to drive a Peugeot 208.

PSA 3121E

NEW PEUGEOT 208

MOTION & EMOTION

PEUGEOT

10th BIRTHDAY

When PM dreams of electric sheep...

We can live with a bit of bling. But a tiara?

Not long after launching the South African edition of POPULAR MECHANICS, we decided it would be a nice idea to present some form of "floating trophy" each month to a PM staff member (or someone in our support team at RamsayMedia) in acknowledgement of good ideas or special efforts – and so was born the quirky but highly coveted **Electric Sheep Award.**

Its name, as you might have guessed, comes from the novel by sci-fi writer Philip K Dick titled *Do Androids Dream of Electric Sheep?* – the inspiration for that 1968 classic, *Blade Runner* (the best sci-fi movie ever made, in the opinion of PM's editor). It started out as a slightly scruffy toy sheep, but after a while we decided it was silly to call it "electric" when it contained nothing even vaguely electrical.

Loyal PM reader Kevin Thorpe duly stepped in, transforming it into a sort of bionic ruminant with glowing red LEDs for eyes. A little switch was secreted beneath the wool, and we had absolutely no idea where he placed the battery, although we suspected it was somewhere rude. The reworked sheep did its job extremely well for the next few years, alternately delighting and frightening its recipients, some of whom thought we were making fun of them (heaven forbid). But then, as so often happens, the proverbial wheels came off.

For reasons that still elude us, we awarded the sheep to someone in our marketing department. We didn't see it again for several weeks, but when it reappeared, our horror knew no bounds: it had acquired red-painted toenails, false eyelashes, pink pearl earrings, a pearl choker, and – wait for it – a jewel-encrusted tiara. The blow to our morale was devastating.

Depressed, we made half-hearted attempts to conjure up some excitement around our "new-look sheep", even adding a couple of er... *male characteristics* in a bid to counter the bling – all to no avail. The end came when we awarded it to someone who promptly tried to give it back.

But it's not over.

In the coming months, as we build and equip our new PopLab for testing anything from high-def TVs to cordless drills, we'll be taking another look at the Electric Sheep – its history, its role in our future, and especially its orientation. Watch this space. **PM**

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power to you

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WIN one of 10 Dremel circular saws valued at R1 599

Precision cuts are what you want. The new hand-held DSM20 SawMAX from Dremel achieves just that! Its features include:

- 710 W motor and non-intimidating abrasive cutting wheel to powerfully cut through common DIY material such as metal, masonry, wood, composites and plasterboard
- Flexible use with cutting depth of up to 20 mm
- Compact, lightweight ergonomic comfort design.

The versatile Dremel DSM20 can perform precise straight cuts, flush cuts close to the surface and plunge cuts with no kickback. Its abrasive wheels allow for both push and pull action. Easy to operate – use just one hand for most cuts – it allows quick accessory swaps using the shaft lock button.

The Dremel DSM20 is suitable for home improvements, installing cabinets, cutting drywall and wood, as well as a wide variety of repair and maintenance work from flooring to tiling, plumbing, kitchen and bathroom installation – even fitting new stairs.

To enter, answer the following question:
How deep can the Dremel DSM20 compact circular saw cut?

SMS: Dremel, followed by the answer, your name and e-mail address to 32697 (R1,50 per SMS) or visit our Web site at *www.popularmechanics.co.za*. **Rules opposite.**

WIN the Revival E5 150 Big Boy Scooter valued at R9 950

The new Revival E5 offers everything you'd expect from a scooter: impeccable styling, a comfortable ride and economical operation.

Engine:
Type: 4-stroke, air-cooled GY7
Displacement: 150 cm³
Fuel consumption: 2,48 litres/100 km at 70 km/h
Max power: 7,68 kW at 8 000 r/min
Max torque: 8,62 N.m at 5 500 r/min
Starting system: Electric and kick-start
Performance
Max speed: 95 km/h
Cruising speed: 60 – 75 km/h
Drivetrain
Transmission: CVT
Clutch: Automatic
Final drive: Belt
Brakes: Front – disc; rear – drum
Tyre size: Front and rear – 3.50/10
Warranty period: 2 year/24 000 km

To enter, answer the following question:
What is the Revival E5 Big Boy Scooter's maximum speed?

SMS: BigBoy, followed by the answer, your name and e-mail address to 32697 (R1,50 per SMS) or visit our Web site at *www.popular mechanics.co.za*. Rules opposite.

WIN one of two Motorola RAZR Maxx smartphones valued at R6 500

The Motorola RAZR Maxx is a powerhouse. On a full charge, its 3 300 mAh battery allows you to host a marathon 17-hour conference call, whip through the Web for seven hours straight, enjoy 15 uninterrupted hours of movies or listen to music for two and a half days. You won't spend your day plugged into the wall.

Plus, its 1 GB of RAM combines with a dual-core 1,2 GHz processor and Android operating system to deliver a lightning-fast user interface and multitasking power. Smart Actions, the intelligent application exclusive to Motorola, automates everyday tasks and the RAZR MAXX comes preloaded with the MotoCast™ app, giving you the power to stream or download content from a computer straight to the device.

It's built tough, too, with a KEVLAR® shell, Corning® Gorilla® Glass protecting the hyper-vibrant 11 mm Super AMOLED Advanced display and a splashguard coating that extends to the electrical boards inside.

To find out more, visit: *www.motorola.com/mobility*

To enter, answer the following question:
How many hours of uninterrupted Web browsing are possible on a full charge of the Motorola RAZR Maxx?

SMS: Motorola, followed by the answer, your name and e-mail address to 32697 (R1,50 per SMS) or visit our Web site at *www.popularmechanics.co.za* Rules below.

WIN the Tamiya M51 Super Sherman radio-controlled tank valued at R11 500

Ready, aim... fire

One of several variants of an Allied forces' armoured mainstay, the US-built M4 medium tank, the M51 Super Sherman is now ready to do duty on domestic (miniature, that is) battlefronts. The front-mounted gearbox contains two Type 380 motors that can operate together or individually to produce forward/reverse running and pivot turning. In addition, realistic sounds accompany engine operations, turret rotation, gun barrel elevation and depression. The hull-mounted main gun can be elevated, depressed, and swung to the left and right.

SPECIFICATIONS

- 1/16th scale.
- Includes DMD Control Unit (T-08) and DMD Multi-Function Unit (MF-07), which enable turret rotation, gun elevation/depression, realistic operating sounds and vibration actions.
- Requires a 4-channel transmitter, 7,2 V battery and 8 AA batteries for transmitter.
- Install separately available Battle System (Item 53447) to enjoy one-on-one or team tank battles with other Tamiya 1/16th R/C tanks.

RECOMMENDED RETAIL PRICE
Tank kit: R10 500
4-channel transmitter and battery: R1 000
To find out more, visit *www.jeffreystein.co.za* for a list of dealers and their contact details.

To catch the tank in action, scan the QR code. (If you don't own a tablet or smartphone, you can view the video on *www.popularmechanics.co.za*).

To enter, answer the following question:
How many motors does the gearbox contain?

SMS: Tamiya, followed by the answer, your name and e-mail address to 32697 (R1,50 per SMS) or visit our Web site at *www.popularmechanics.co.za*. Rules below.

RULES 1. Entry is open to anyone except employees (and their immediate families) of RamsayMedia, in addition to employees (and their immediate families) of the following companies and associated agencies in their specific competitions: • Motorola RAZR Maxx: Motorola; • M51 Sherman tank: Jeffrey Stein; • Dremel saw: Dremel; • Big Boy Revival ES 150: Big Boy Scooters. **2.** Only one online entry per person. You may enter via SMS as many times as you like (SMS charged at R1,50). **3.** Competition runs until 31 August 2012. **4.** We will draw the winner(s) on 10 September 2012. **5.** The prize is not redeemable for cash. **6.** The judges' decision is final and no correspondence will be entered into. **7.** Regrettably, only South African residents are eligible for prizes. ***8.*** Prizes not claimed within 3 months will be forfeited.

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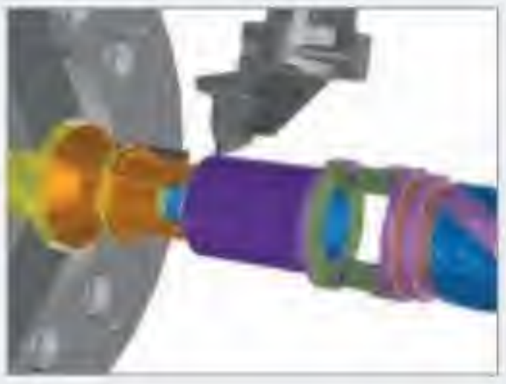


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YOUR AFFORDABLE WIRELESS SOLUTION

EMBRACE your techno-future!

After three groundbreaking years as host of the annual PM Inventors Conference, POPULAR MECHANICS is launching a new and even more ambitious event that's destined to light a fire in South Africa's vibrant tech community. Titled **FutureTech**, it's a forward-looking conference aimed at anyone who cares where their world is heading, embracing and celebrating technologies that are already changing our lives beyond recognition.

Breathtaking advances in computing power, the explosive spread of wireless connectivity, the ever-evolving Internet, breakthroughs in consumer tech, the social media landscape, humanity's relationship with technology, our automotive future... all this, and more, will be tackled by presenters at the top of their game. They'll introduce a slew of fascinating concepts, deconstruct the most significant breakthroughs, and reveal what's coming next. The theme of the inaugural conference is "**Connect**", a word that will resonate with anyone who understands the mechanics of the 21st century.

The inaugural **FutureTech** conference happens on 25 October 2012 in Johannesburg; bookings are open now. To reserve and pay for your seat, please visit *www.magsathome.co.za*. For more information, e-mail Nomfundo Calana on *nomfundoc@ramsaymedia.co.za* with "**FutureTech updates**" in the subject line, or call her on 021-530 3204.

In the meantime, here's a taste of what's to come (more programme details will follow in the coming weeks):

GEORGE ELLIS, Emeritus Distinguished Professor of Complex Systems in the Department of Mathematics and Applied Mathematics at the University of Cape Town. Professor Ellis co-authored *The Large Scale Structure of Space-Time* with University of Cambridge physicist Stephen Hawking (in 1973), and is considered one of the world's leading theorists in cosmology.

HIS SUBJECT: "Science, Technology and Humanity."

TIM NOAKES, Professor in the Discovery Health Chair of Exercise and Sports Science at the University of Cape Town. He is also director of the UCT/MRC Research Unit for Exercise Science and Sports Medicine, and co-founder (with rugby legend Morné du Plessis) of the Sports Science Institute of South Africa.

HIS SUBJECT: "Your Body, Your Future: Getting the Science Wrong."

ALAN KNOTT-CRAIG is founder of *World of Avatar* and CEO of Mxit, Africa's largest social network. Between 2003 and 2006, he co-founded five companies in the mobile services sector. He's a former MD of broadband network operator iBurst and author of the best-seller *Don't Panic*, a book aimed at persuading emigrant South Africans to return home.

HIS SUBJECT: "In Pursuit of a Better-Connected Planet."

JAMES MUNN is vice-president of business development in sub-Saharan Africa for wireless giant Qualcomm. Based in Johannesburg, he manages Qualcomm's strategic relationships with OEMs and the company's regional customers, including network operators and carriers, mobile handset vendors and software developers.

HIS SUBJECT: "How Wireless Rules the World."

PITCH IT TO THE PANEL. Reprising a popular segment from last year's event, we'll be inviting finalists from our annual PM Inventors Competition to present their inventions to our panel of experts (and to you, the audience) for comment and advice. You'll be impressed and inspired by their home-grown ingenuity.

JUST THE FACTS

- The one-day FutureTech conference takes place on 25 October 2012 in Johannesburg.
- Only 200 seats are available at an "early bird" cost of R1 595 each (offer closes on 31 August 2012). Thereafter, the fee increases to R1 895.
- All bookings close on 12 October 2012. Updates will be announced via our Web site, our weekly Web letter, our Facebook page and other media channels.

futuretech2012

TOMORROW'S TECHNOLOGY TODAY ● Popular Mechanics *Be the first to know*

Popular Mechanics

Secure STYLE

Groundbreaking safety tech is a given with a new Volvo. The V40 goes one step further with striking hatchback style and 'human-centric' design

BY ANTHONY DOMAN

Safety has always been a Volvo hallmark. Style and panache... perhaps not so much. But the Swedes have managed to combine the sensible and the sensational in their slinky new V40 hatchback.

Previously regarded as more of a station wagon version of the S40, the new V40 has been conceived as a sibling to the company's compact C30 hatchback, in five-door five-seater configuration. Styling cues evoke the C30 and further back, the classic P1800ES: that "hook" at the top of the rear door, for instance, and the hexagonal tailgate.

Born out of what Volvo calls its "Designed Around You" concept, the sporty-looking V40 exhibits the human touch in such features as instrument display themes (Eco, Elegance and Performance – although these are all purely visual), seven different mood lighting settings and even a V40 smartphone app. The interior design and styling are very much in line with market expectations in this segment: curvy surfaces, lashings of brightwork, a transparent lit-up gearknob and frameless rear-view mirror to match your iPhone.

Of course, that human-centric approach incorporates some groundbreaking safety tech – a world-first pedestrian airbag, for instance – in a package clearly aimed at the likes of BMW's trendy 1 Series in the premium hatchback sector.

For the world launch of the new vehicle we travelled to Verona, Italy, the setting for the tragic tale of Shakespeare's star-crossed lovers. But forget Romeo, there was more interest in roadholding. And the V40 coped superbly with the sinuous switchbacks and precipitous mountain passes threading the high-lying areas around the town. It also revealed that it has more than a hint of sportiness in its makeup, too. There's a reassuring feeling of stability and solidity about this car.

The V40 has two different chassis setups: Dynamic chassis as standard, and an optional Sport chassis that is 10 mm lower, with firmer suspension settings. The electrically assisted steering has 3-level boosting: low for low-speed manoeuvring, medium for everyday driving and high for performance-oriented driving. Being electrical, it is easily integrated with vehicle systems such as Lane Keeping Aid and Park Assist Pilot.

The entry level manual-shift D2 diesel pulls vigorously, but betrays a trace of nose-heaviness in really tight corners and lacks just a little low-down urge. The more powerful petrol-engined model feels raring to go. Paradoxically, the automatic transmission fitted to the T4 petrol model we drove seemed to be less well suited to brisk driving; finding and remaining in the right gear didn't always happen as expected, and often the 'box would upshift, robbing the car of forward momentum. But although we might quibble about the balance between engine and transmission, there's no question that the car's chassis is superbly balanced and responsive.

For techno-geeks, the big news is the car's safety systems. Here's a quick rundown.

PEDESTRIAN AIRBAG

Sensors in the front bumper register the physical contact between the car and the pedestrian, releasing the rear end of the bonnet, which is lifted by the deploying airbag. The inflated airbag covers the area under the raised bonnet plus about one-third of the windscreen area and the lower part of the A-pillar.

VIDEO > Visit *www.popularmechanics.co.za* to see video of the Volvo V40's safety tech.

LANE KEEPING AID ①

A camera monitors the left and right lane markings, detects if the car seems to be drifting out of the lane, and applies extra steering torque to the steering column when the car gets close to a lane marking and is about to leave the lane. The system is active at speeds between 65 km/h and 200 km/h. If the car leaves the lane, a haptic vibration in the steering wheel provides a warning. Using the indicator overrides this function.

ROAD SIGN INFORMATION ②

A forward-looking camera can detect speed limit signs as well as "no overtaking" signs and displays these in the instrument cluster.

ENHANCED BLIND SPOT INFORMATION SYSTEM ③

The V40 features an enhanced version of Volvo's radar-based BLIS, which is now able to spot a vehicle approaching in the rear blind spot up to 70 metres away, using sensors located in the rear corners of the car, behind the bumper cover.

CROSS TRAFFIC ALERT

Cross Traffic Alert uses the radar sensors at the rear of the car to alert the driver to crossing traffic from the sides when reversing out of a parking space. It's able to warn of traffic up to 30 metres from the car – even smaller objects such as bicycles and pedestrians.

ACTIVE HIGH BEAM

A forward-facing camera monitors other vehicles and their front and rear lights. Advanced image processing software analyses this data and provides information about their position and direction. The calculation serves as the basis for automatic switching between low and high beam.

PARK ASSIST PILOT

To take the pain out of parking, Park Assist Pilot operates the steering wheel while the driver handles the gearbox and controls the car's speed. The parking manoeuvre is based on front, rear and side-facing ultrasonic sensors. When a parking slot measuring a minimum of 1,2 times the car's length is detected, the driver is notified by an audible signal and advised to stop via a message in the instrument cluster.

The display guides the driver step by step via texts and animations in the instrument cluster until the car is correctly parked.

PEDESTRIAN DETECTION

Imagery from a radar unit integrated into the car's grille and a camera fitted in front of the interior rear-view mirror is analysed to determine if, and how far, a pedestrian or vehicle is in front of the car. Even pedestrians about to step into the roadway can be detected early on. The system uses visual and audible warnings and can apply the brakes – as much as full braking to standstill at up to 35 km/h.

CITY SAFETY

Volvo's upgraded City Safety anti-collision system gets its first outing in the V40; previously active up to 30 km/h, it is now able to brake the vehicle automatically up from speeds up to 50 km/h, using a laser sensor to detect if the V40 is approaching a stationary vehicle too fast.

DRIVER ALERT CONTROL

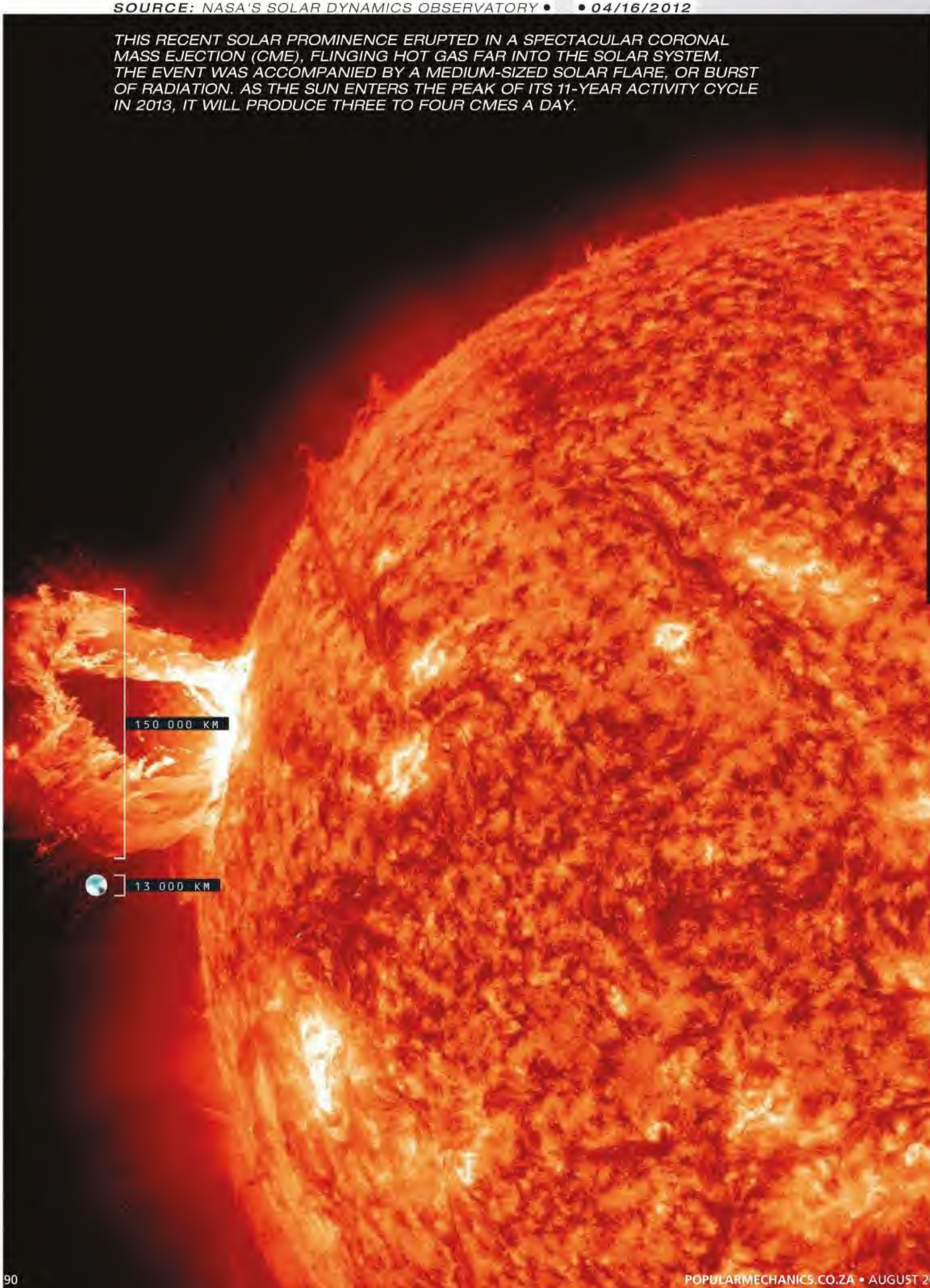
Using the onboard camera, sensors and a control unit, the system continuously registers the car's movements and is able to assess whether the driver risks losing control of the vehicle. If the risk is assessed as high, the driver is alerted via audible or visual signals.

- When the V40 hits South Africa towards the end of this year, the likely engines are manual-shift turbocharged petrols of 110 kW (T3) and 132 kW (T4) plus the auto-shift 84 kW D2 turbodiesel. The 187 kW T5 petrol and 110 kW D3 diesel will follow next year. Incidentally, all engine versions have start-stop and braking energy regeneration.

Official prices will be announced closer to the launch date, but expect pricing to range from about R300 000 to R400 000. **PM**

SOURCE: *NASA'S SOLAR DYNAMICS OBSERVATORY* • • **04/16/2012**

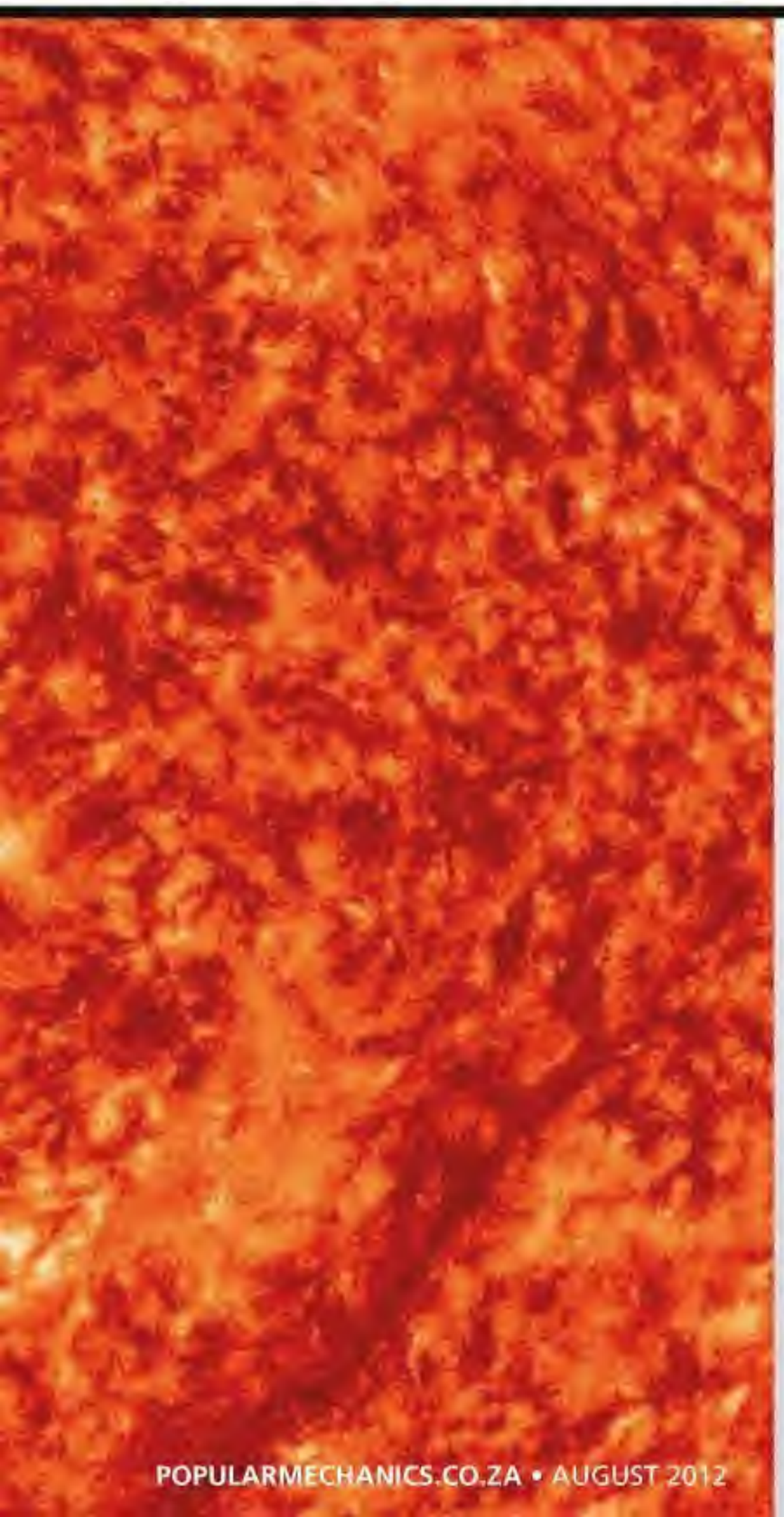
THIS RECENT SOLAR PROMINENCE ERUPTED IN A SPECTACULAR CORONAL MASS EJECTION (CME), FLINGING HOT GAS FAR INTO THE SOLAR SYSTEM. THE EVENT WAS ACCOMPANIED BY A MEDIUM-SIZED SOLAR FLARE, OR BURST OF RADIATION. AS THE SUN ENTERS THE PEAK OF ITS 11-YEAR ACTIVITY CYCLE IN 2013, IT WILL PRODUCE THREE TO FOUR CMES A DAY.



WELCOME TO THE NEW **SOLAR MAXIMUM**

> BY LEE BILLINGS

The Sun has been hurling plasma at Earth for billions of years, but the next direct hit could damage power grids and other infrastructure – immobilising the technology that underpins civilisation.



FOR MORE THAN A WEEK, Nasa officials cautiously watched as vast plumes of material, at temperatures of tens of millions of degrees, arced from the far side of the Sun. Then the culprit spun into view: a region of sunspots more than 13 times the diameter of Earth, bubbling with volatile magnetic fields. Then, at about 1 am South African time, the region erupted, releasing a pulse of hot, electrified gas that shot towards the planet at millions of kilometres an hour.

It was 28 October 2003, and in the Service Module of the International Space Station, astronaut Michael Foale and cosmonaut Alexander Kaleri had just downed coffee as they prepared for the first full working week of their 195-day mission. The station's orbit was sweeping the craft towards the South Atlantic Anomaly, an area above the eastern coast of South America where high-energy particles from the Sun become concentrated.

Mission control called, Foale remembers. "They said, 'Hey, we've got some big events coming. We recommend you shelter in your crew station, Mike'." With the radiation units on his personal dosimeter ticking upward, Foale floated 60 m down two long tunnels to his sleeping quarters near the front of the station. He closed himself in the coffin-like room, lined with thick polyethylene foam bricks to shield his body from the protons flying through the station – the product of one of the most powerful solar flares ever recorded.

Outside, the craft glided through a curtain of brilliant green light – an aurora, created by electrons colliding with oxygen in Earth's atmosphere. "It was very dramatic and quite spectacular," Foale says. But to be enveloped in that energy is unsettling. "Obviously you think, this is not good," he says.

At 1:30 am, a satellite stationed between the Sun and Earth observed the star gain an ominous halo, the telltale sign of a coronal mass ejection (CME). The billion-ton belch of magnetised plasma reached our planet the following morning. It slammed into Earth's magnetic field, which vibrated like a bell, and in a manner analogous to a moving bar magnet raising currents in a coil of wire, the CME sent powerful electric currents coursing through the planet. Those ground currents flowed into power lines; electric grids around the world strained.

In North America, utility companies scaled back generation. In Sweden, a high-voltage transformer blew, blacking out the city of Malmö for almost an hour. The barrage of solar particles continued for days, interfering with satellites and radio communications; auroral lights danced across the sky as close to the equator as Florida and Australia. Roughly a week later, the Sun's most active regions rotated out of alignment with the planet. No lives were lost, but the storm had caused many hundreds of millions of dollars in damage.

The Sun's activity roughly follows an 11-year cycle, and severe space weather tends to cluster around each cycle's peak. The sun is now entering the peak of Cycle 24, as evidenced by powerful solar storms it unleashed in January and March this year. Those storms had little effect on Earth, largely due to chance: the orientation of the planet's magnetic field caused much of the radiation to slide over it. The next big CME will test that luck.

This deeply worries John Kappenman, founder of Storm Analysis Consultants and an expert on the effects of geomagnetic storms. His detailed investigations of the so-called Halloween Storm of 2003 found that it, too, had been dampened by the alignment of Earth's magnetic field. And yet it still blacked out an entire city and stressed continental power grids. If the planet had absorbed the full brunt of the CME, the blackout could have had far more severe repercussions.

"If you lose electricity, within a matter of days you essentially lose almost everything else," Kappenman says. "After the initial blackout, we wouldn't really understand the seriousness of the situation until several days went by without having things restored. We'd rapidly lose the ability to provide the necessities for modern society."

'The physics of the Sun and of Earth's magnetic field have not fundamentally changed, but we have. We decided to build power grids, and we've progressively made them more vulnerable as we've connected them to every aspect of our lives.'

— John Kappenman, Storm Analysis Consultants

2 **This may seem like doom-saying,** but the historical record suggests otherwise: the Halloween Storm, in fact, appears minor compared with several earlier events. In March 1989, a geomagnetic storm knocked out a high-voltage transformer at a hydroelectric power plant in Quebec, plunging the province into a 9-hour blackout on an icy winter night. A storm that enveloped Earth in May 1921 sparked fires in telegraph offices, telephone stations and railroad routing terminals connected to nascent power grids. The most extreme observed storm of all, called the Carrington Event, occurred in September 1859: it caused geomagnetic currents so strong that for days telegraph operators could disconnect their equipment from battery power and send messages solely via the "auroral current" induced in their transmission lines.

"The physics of the Sun and of Earth's magnetic field have not fundamentally changed, but we have," Kappenman says. "We decided to build power grids, and we've progressively made them more vulnerable as we've connected them to every aspect of our lives. Another Carrington Event is going to occur some day." But unlike in 1859, when the telegraph network was the sole technology threatened by space weather, or in 1921, when electrification was in its infancy, today's at-risk systems are legion.

Over the past 50 years, global power-grid infrastructure has expanded tenfold. Meanwhile, utilities have shifted to higher operating voltages, which increase the efficiency of electricity transmission but make equipment less resistant to unregulated ground currents. As the grid has grown, so too has the practice of importing and exporting electricity between regions and even countries: a streetlight in upstate New York may be powered by a hydroelectric plant in Quebec; a neon sign outside a Tijuana nightclub may glow because of a natural-gas plant in southern California. This interdependency increases the risk of widespread collapse. Humans have effectively created continent-size antennae – all exquisitely tuned to soak up currents caused by space weather.

Over the years, Kappenman has undertaken a series of studies underwritten by various branches of the federal government. He has consistently found that a great geomagnetic storm, striking with little forewarning, would overheat hundreds or thousands of high-voltage transformers in the US grid, melting crucial components and effectively crippling generation capacity. Building replacement transformers at current production rates would take up to 10 years, during which time more than 100 million people would be without centrally provided power. This would cost the US economy an estimated R8 trillion to R16 trillion in the first year alone.

Last year, the US Department of Homeland Security asked an independent group of elite scientists, the JASON Defence Advisory Panel, to analyse Kappenman's claims. In its November 2011 report, the panel expressed scepticism that his worst-case scenario could occur, but agreed that the US power grid could suffer severe damage from a geomagnetic storm. The scientists called for more space-weather safeguards, including hardening electrical infrastructure and bolstering America's ageing network of Sun-observing satellites.

Physicist Avi Schnurr, who presides over the non-governmental Electric Infrastructure Security Council, is among those who doubts that modern society will successfully address the problem. "If a Carrington Event happened right now, it probably wouldn't be a wake-up alarm – it would be a good-night call," he says. "This is a case where we have to do something that is not often successfully achieved by governments, and certainly not by democracies: we have to take concerted action against a predicted threatening event without having actually experienced the event itself in modern times."

Protecting the grid is, in principle, relatively straightforward. Most high-voltage transformers connect directly to the ground to neutralise power surges from lightning strikes and other transient phenomena – but that also allows geomagnetic currents to flow upward. Experts estimate that electrical resistors or capacitors, which would sever that connection, could be installed at critical locations (such as near power plants or major cities) within a few years. In practice, however, it's not so easy: US power companies have balked at voluntary installation of such devices, which could cost about R800 000 per transformer.

Peter Pry, a former Central Intelligence Agency official and staff member

How a solar storm works

During a coronal mass ejection, the Sun violently blasts high-energy particles travelling several million kilometres an hour into space. When these particles sweep into Earth's magnetosphere a day or so later, they set off a geomagnetic storm.

1 High-energy protons and electrons pass through spacecraft such as the International Space Station, damaging electronics and degrading solar arrays.

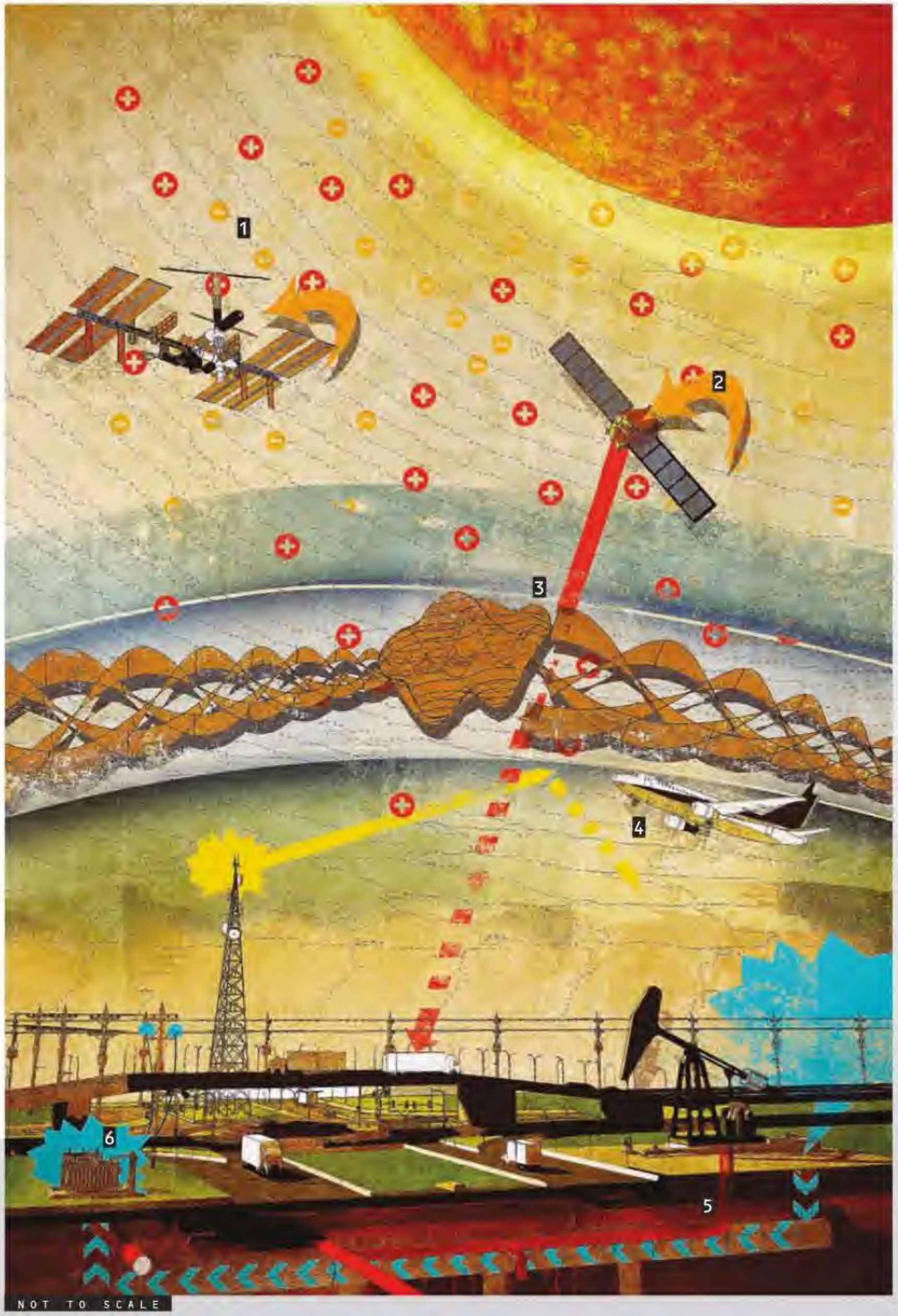
2 They also heat and expand the upper atmosphere, which increases **drag on satellites**, reducing their lifetimes in orbit.

3 Earth's ionosphere becomes distorted with radiation, and plasma bubbles form. **GPS signals scintillate, or break up**, as they pass through this region, disrupting the triangulation of points necessary for precise navigation.

4 Ionised particles also affect the propagation of radio waves. Aircraft flying above 85 degrees latitude rely exclusively on high-frequency radio communications, and so may be rerouted.

5 Vibrations in Earth's magnetic field induce strong electric currents in the ground. These follow the path of least resistance **into oil and gas pipelines, causing corrosion.**

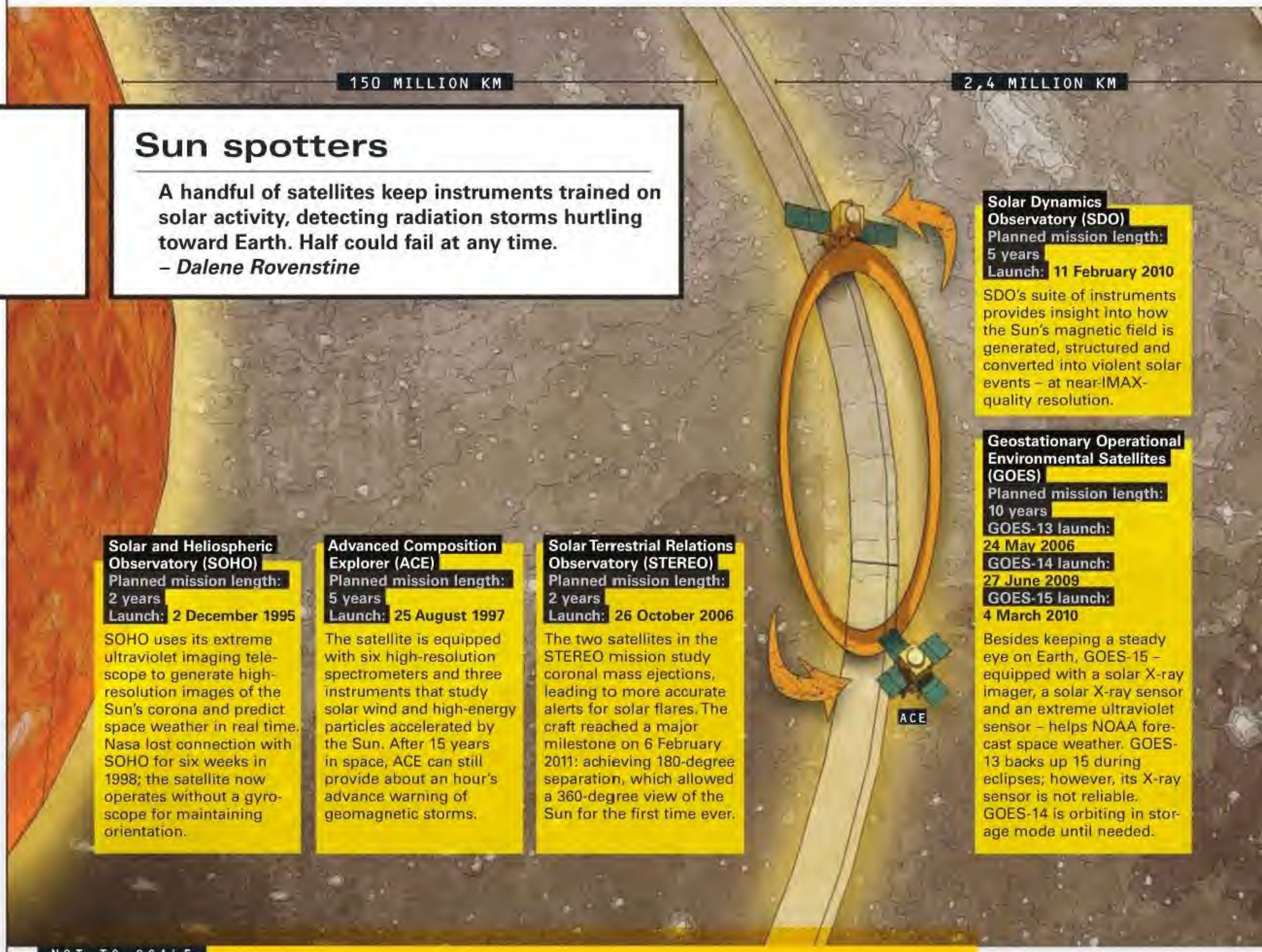
6 They also flow into power-grid infrastructure such as transformers, which can blow out from the sudden burst of unregulated current.



VIDEO > Visit *www.popularmechanics.co.za* to watch a video of the flare unleashed in January this year and to download wallpaper images of the Sun.

Sun spotters

A handful of satellites keep instruments trained on solar activity, detecting radiation storms hurtling toward Earth. Half could fail at any time.
– Dalene Rovenstine



on the US House Armed Services Committee, has tried to spur legislative action on the threat of space weather. He has also watched in frustration as bills mandating protection of the grid repeatedly went nowhere. "The real danger here isn't astrophysical, it's institutional," he says. "The threat to everyone belongs to no one."

3 **POWER OUTAGES** wouldn't be the only cause of cascading failures in the event of extreme space weather. Jane Lubchenco, head of the National Oceanic and Atmospheric Administration (NOAA), points out that highly charged particles can also degrade the precision of GPS satellites. Signals from these networks allow receivers to calculate geospatial positioning and measure time to billionths-of-a-second accuracy. Besides providing directions for road trips, they synchronise cellphone conversations, orchestrate air traffic, and guide fleets of emergency vehicles.

"Today, most financial transactions are date-stamped with GPS, and GPS guides the dynamic positioning of most deep-ocean oil and gas operations," Lubchenco says. "Can you imagine the financial disruption that a GPS outage would cause? Can you imagine the Deepwater Horizons that would occur if drilling platforms received erroneous GPS information?"

For now, the only way to ensure

The first light of Nasa's Solar Dynamics Observatory, shown at a press conference on 21 April 2010.

that power grids and satellite networks withstand another Carrington Event would be to pre-emptively shut them down when a big storm is likely to occur. "That's really not a good solution," Kappenman says. For one thing, each self-enforced outage would cost billions in lost productivity. For another, he says, "forecast systems probably aren't ever going to be precise enough to avoid false alarms".

Thomas Bogdan, former director of NOAA's Space Weather Prediction Centre in Boulder, Colorado, acknowledges "our ability to forecast is actually fairly poor". CMEs and solar flares will be particularly difficult to predict without better theoretical models of the circulation of plasma in the Sun, but CMEs reliably occur three or four times a day during our star's activity peak, and approximately once a week during solar quiescence. "The only reason we really get by is that the Sun has a regular activity cycle," Bogdan says.

The prediction centre relies on constant surveillance of the Sun for the slightest indication of a threatening event. Initially, this comes from ground-based observatories operated by the US Air Force and a NOAA satellite network watching for the telltale X-ray pulses that signal solar flares. But only a few satellites – including the Solar and Heliospheric Observatory (SOHO) and the two Solar Terrestrial Relations Observatory (STEREO) spacecraft – can detect whether a radiation storm or CME is actually headed towards the planet. The Advanced Composition Explorer (ACE) can measure the intensity and magnetic orientation of any CME that sweeps by it. But 20 to 50 minutes later, forecasters can merely watch the storm unfold on Earth.

Disturbingly, both SOHO and ACE are well past their nominal lifetimes, with no certain replacements. "Once SOHO ceases functioning, probably in the next year or so, we won't have its unique 'looking down the barrel of a gun' perspective on the Sun for forecasting Earth-directed CMEs," says Sten Odenwald, an astrophysicist affiliated with Nasa's Goddard Space Flight Centre.

ACE has sufficient propellant to continue operations until roughly 2024, but there are no guarantees its instruments will last that long. Without ACE, Odenwald says, "we'll (still) be able to see a CME coming towards us, but we won't know whether its interaction with Earth's magnetic field will cause major fireworks or be relatively harmless".

STEREO and another satellite, the Solar Dynamics Observatory, may be able to compensate for SOHO's eventual loss, but Lubchenco and other experts unanimously believe that allowing ACE's unique observational capabilities to expire would constitute a blind spot too large and risky to ignore. "Another great geomagnetic storm probably won't happen tomorrow, but that doesn't mean we shouldn't worry," Bogdan says. "The good news is, we've got time to prepare for this, but the bad news is, if we don't hedge our bets and buy down some risk, one day we're gonna get clobbered."

In fact, a spacecraft that could replace ACE currently sits in storage at Goddard's facility in Greenbelt, Maryland. The Deep Space Climate Observatory, or DSCOVR, is fully assembled and all but ready for launch – Nasa simply lacked the funding to launch it into space seven years ago. As part of the Obama administration's budget request for 2012, NOAA would receive R380 million to refurbish and launch DSCOVR to act as ACE's replacement, but the initiative died in the House of Representatives.

After Foale rode a Soyuz TMA-3 capsule back to Earth in April 2004, he had blood drawn for an experiment that monitored his chromosomes. "Roughly, the rate of damage to my white blood cells went up by a factor of 10," he says. It dropped back down within the year. "Life has been dealing with radiation since it began," Foale says. "Repair mechanisms in the cells are very sophisticated."

Human society, on the other hand, has evolved to be more fragile – complex, yet defenceless against a storm of solar radiation. Meanwhile, the Sun continues to seethe. **PM**

I'LL TRY **ANYTHING**

BY JEFF WISE

PM'S REPORTER TURNED OFF-ROAD WARRIOR NAVIGATES THE FLORIDA EVERGLADES IN A DIY BUGGY.

The 2 200 kg metal beast pitches me forward as it lurches to a stop. A couple of metres below, swamp water sloshes in front of our 1,2 m-high tractor tyres, rousing an alligator that wriggles away for cover. I ease the accelerator forward and begin to move, feeling my way across the submerged potholes. It's like riding a swaying, noisy metal elephant.

There are reasons to take things slowly – vehicles have vanished into the sucking mud of the Everglades. "It's an extreme environment," says Gene Van Schaick, 70, the builder and owner of the behemoth I'm piloting. "It'll kick your ass."

I've met up with Van Schaick to experience the landscape he loves best – the wetlands of southern Florida – aboard the machine he's most passionate about: the swamp buggy. Most people tend to associate "swamp" with words such as "stagnant" and "malaria", and think of swamp buggies as dirt-flinging hot rods that race up and down mud wallows. But Van Schaick's swamp buggies are slow, utilitarian vehicles, and as for the swamp – well… "I don't know what people think of when they trash-talk swamps," he says.

The author in Gene Van Schaick's homemade buggy, which was constructed using plate metal, steel channel and parts from military vehicles. It can drive through 1,8 m of water.

"I love the swamp. I love the views. I love the smell."

One point he'll concede: the swamp is hard to navigate. In recent geological time, the area was limestone and coral reef, and it's still so flat that the torrential rains of summer and fall are slow to drain. For all but a brief dry season, waterlogged marshes and open water predominate. Anyone trying to hike in has to contend not only with the sheer physical exertion, but dense vegetation, hungry alligators, clouds of mosquitoes, and four kinds of poisonous snakes.

For all its rigours, the backcountry has much to offer in the way of recreation; though an easy drive from Miami, it's full of game to hunt, as well as exotic specimens to lure the bird-watcher and flora enthusiast. To tap those opportunities, intrepid Floridians began a century ago to retrofit Model A and T Fords with big wheels and extra-low gearing. Today, a small but passionate subculture of builders – including a group founded by Van Schaick in 1990 – carries on that legacy.

On a warm day in early February, Van Schaick takes me to the edge of an airstrip halfway between Miami and Naples, Florida. Some two dozen beefy, hard-driven machines are lined up, each one unique, having been designed and cobbled together – mostly out of plate metal and parts of other vehicles – by one of the 65 members of his club.

Van Schaick, a retired carpenter, spent six years building his behemoth, *Gray Ghost*. The Goodyear tyres yield 65 cm of clearance. The solid-steel tie rods are behind the axle for protection against cypress knees, the club-like growths that sprout from the roots of cypress trees. (If the knee hits the axle first, it won't be able to take out the tie rods.) The engine is a 2,8-litre V-6 from a 1982 Chevy Citation, without the fuel-injection system – Van Schaick stripped it out and replaced it with a carburettor. "Everything needs to be rugged and simple," he says, "so you can fix it while standing in a metre of water."

Van Schaick and I clamber on top of the buggy, which, from up here, looks like a boat – fitting for a vehicle that can negotiate water at the depth of a tall man. I fire up the engine and we head out. Past the parking lot are 9 800 ha of county-owned land. Although the landscape is nearly identical to the federally administered Big Cypress National Preserve next door, there are fewer restrictions on its use.

Soon, we're axle-deep in muddy water, moving across the cypress prairie. The landscape looks like something out of *Dr Seuss*, an expanse of twisted grey trunks garlanded with bushy bromeliads bearing spiky red flowers. Further on, the road becomes hemmed in by a forest so dense it feels like we're driving through a tunnel. Our wheels churn up mud the consistency of brownie batter. We never move faster than walking pace, and after an hour-and-a-half we've covered only 8 km.

Van Schaick takes the wheel and gives me a tour, from the high ridges and island-like hardwood hammocks that remain partially dry year-round to the sediment-filled saw-grass ponds that during the wettest months become, as he puts it, "bottomless". Van Schaick has seen lots of things in these wetlands over the years. Once he surprised a panther while on foot. "It was less than 10 metres from me," he says. "It went straight up, turned in the air, and headed the other way."

I'm surprised at how pleasant it is. There's no oppressive stench; the water in the Everglades isn't stagnant, but part of a broad, slow-moving flow. Snakes and alligators thrive here; so do deer, wild hogs and turkeys. Without buggies, much of this verdant wilderness would be all but inaccessible. "It's uncomfortable for hiking, and it's easy to get turned around," Van Schaick says. "Anyone who doesn't know the area well isn't going to be able to penetrate the interior."

Nevertheless, the machines have their detractors. "They are detrimental to the environment," says Matthew Schwartz, executive director of the South Florida Wildlands Association. "The ground is very fragile, and when you put that much weight on it, the soil doesn't recover. It erodes right down to the limestone." Schwartz's group wants to keep motorised recreation from expanding within Big Cypress. But Van Schaick counters that most of the soil eroded by swamp buggies is replenished during each yearly cycle of flooding.

As we stop at a saw-grass pond and kill the engine, we can imagine that except for the machine under our butts, there is no sign of civilisation. We could be in some remote wilderness, not an hour from one of the East Coast's biggest cities. A breeze moves across the tall green stalks of the saw grass, bearing a sweetly resinous tang. Overhead, two hawks coast, circling stiff-winged on the warm air. "I love the tranquillity of this place," Van Schaick says. "Apart from the buggy tracks, it's just the way it's been for hundreds of years." **PM**

BAD VIBRATIONS

I have a problem when opening a window in my SUV while driving. There's a *boom, boom* sound that affects everyone in the car and it's worse if it's the driver's window. What can be done to eliminate this problem?

A What you're experiencing is called buffeting and it's not unique to your SUV. To boil down some very complicated physics as simply as possible, when you open a window you're piercing what's known in aerodynamics as a boundary layer. The air racing past your car is at a lower pressure than the air inside the cabin, so opening a window means the inside air wants to get out; however, the air rushing by outside gets snagged on the edges of the open window and tries to get inside. The cabin air resists this intrusion while the pressure tries to equalise and the two layers of air "bounce" off each other. This turbulence in the boundary layer causes a rumbling sound that can be painful to the ears.

The effect of buffeting varies based on the cabin shape and aerodynamics of your vehicle, as well as the speed you're travelling. There's an easy fix, though – give the air inside somewhere else to go. Rather than open just one window, crack open a second or the sunroof so the pressure will be relieved. I've found the opposite-corner window works best.

PUT A RING ON IT

Q Recently a tone ring on my 2007 Ford SUV cracked and fell off. The dealer said replacing the entire front halfshaft was the only option. What a waste of a perfectly good shaft. Can I weld the ring and, if so, what can be used to reattach it to the shaft – epoxy?

A Tone rings are central to the operation of traction-control systems. For your particular vehicle, they're on the end of the halfshaft that connects the transmission to the wheels, riding on the constant velocity joint housing. A tone ring looks like a gear and fits on or near the hub of each wheel of a car. A sensor sits near the ring and detects the presence or absence of one of those gear teeth. By calculating how fast the teeth are moving, the car's computer knows how fast each wheel is turning. After comparing the wheel speeds with what it expects to see, the computer decides if any wheels are slipping under acceleration or braking and makes corrections with the brakes and/or the engine output. Because the ring cracked and fell off, the car can't tell what's going on at that corner, leaving the antilock brakes and stability-control systems hobbled. Needless to say, the problem should be fixed.

I know it's tempting to try a cheap fix like glueing the ring on again, but trust me, it's not worth the effort. I called some parts stores and found you could buy reasonably priced remanufactured front axles after a core return. If you take in the old damaged part you get a partial refund. Remanufacturers take the damaged parts and tear them down, clean up the main components and rebuild them for future customers. With basic know-how, some simple tools, and maybe a good service manual, changing a halfshaft takes just a few hours in your driveway. You get a good-as-new part, and that otherwise perfectly good axle will see another life.

CHAT ABOUT CHATTERING

Q The clutch on my elderly Toyota Corolla chatters whenever I pull away from a traffic light or stop street, making the whole car shudder. Now my wife is starting to give me that look. Are we in for an expensive repair job, or is there some way to extend the life of the clutch while eliminating the shake?

A Sadly, you're probably out of luck. There's a slim chance that the problem could be caused by loose mounts or shackles (in which case, all that's required is a relatively simple adjustment), but more likely culprits include a warped or worn clutch plate, binding pressure plate fingers, a worn pilot bearing, a warped or scored pressure plate, an oil-contaminated clutch plate... it's a long and painful list. In most cases, this will entail the replacement of at least the clutch disc (possibly the pressure plate, too) and the installation of a new pilot bearing. And yes, it will cost.

Don't be an idiot

OPEN A HOT RADIATOR CAP

Engines operate at high temperatures, which means their cooling systems must work within this range as well. Only problem is, coolant can boil in that heat, which makes for inefficient thermal exchange. So just as a pressure cooker raises water's boiling point, the cooling circuit is pressurised to do the same. Assuming your engine is working properly, the coolant is under between 0,7 and 1,0 bar of pressure when hot. Opening the cap to atmospheric pressure causes rapid depressurisation of the hot coolant, and that liquid converts to dangerous steam. Cars with overflow tanks keep pressure sequestered with a spring-loaded valve, but it's better to be safe, and let the engine cool before opening the system for service. When in doubt, place a damp towel between your hand and the cap. PM

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UPGRADE

COMPILED BY THE EDITORS
popularmechanics@ramsaymedia.co.za

BE STILL, OUR HEARTS

Gorgeous, skinny, desirable. And it computes!

Announced just a few weeks ago, Apple's all new 15-inch MacBook Pro has just kicked its opponents out of the ring, then stomped on them for good measure. First, there's the gorgeous Retina display, all-flash storage and quad-core processors. Then there's the breathtakingly light (it weighs in at a modest 2 kg) and skinny case: at 18 mm, it's almost as thin as the MacBook Air, for heaven's sake.

With over 5 million pixels – that's around 3 million more than an HD television – the display is billed as the world's highest-resolution notebook display. At 220 pixels-per-inch, its pixel density is so high that the human eye cannot distinguish individual pixels from a normal viewing distance, with the result that text and graphics look incredibly sharp.

The display reportedly has 75 per cent less reflection and 29 per cent higher contrast than the previous generation.

Is Apple's widening adoption of flash storage – which delivers what you need up to four times faster than traditional notebook hard drives – a harbinger of the way things are going? Is the company serious about taking over the world? Future shocks aside, the new MacBook Pro is able to play four simultaneous streams of uncompressed 1080p HD video from internal storage – and that's a very compelling ability indeed. It ships with OS X Lion (no surprise there).

Now to the engine room. You get Intel Core i7 quad-core processors up to 2,7 GHz (Turbo Boost speeds this to 3,7 GHz), Nvidia GeForce GT 650M discrete graphics, up to 16 GB of faster 1 600 MHz RAM, and flash storage up to 768 GB. Two Thunderbolt and two USB 3.0 ports allow you to connect to multiple displays and high performance devices, and a new HDMI port offers quick connectivity to HDTVs.

It won't die on you, either. The battery is said to deliver up to 7 hours of wireless productivity, using "advanced chemistry" (!) and adaptive charging technology to provide up to 1 000 recharges. That's not all; the specs include a FaceTime HD camera, glass multi-touch trackpad, full-size backlit keyboard, dual microphones, enhanced speakers, 3-stream 802.11n Wi-Fi, and a thinner MagSafe 2 power port.

Prices range from R23 999 to a formidable R29 999 for the top-specced model.

VIDEO > Visit *www.popularmechanics.co.za* to catch the Audi e-bike Wörthersee in action.

MEET THE WORLD'S SMARTEST BICYCLE

It's not just about muscle power any more

If we were in charge, we would have called this bike *Lightning*, or *Blitz*, or something appropriately sexy. The folk at Audi, on the other hand, thought it would be quite cool to honour it with the location of the annual get-together for Audi, VW, Seat and Skoda fans – so they've called it Audi e-bike *Wörthersee*.

Odd nomenclature aside, the radical-looking prototype is quite something. It combines electric drive with muscle power, reportedly producing a top speed of 80 km/h using both. The rider can choose from a total of five cycling modes – pure muscle power, electric motor alone, or pedalling with support from the electric motor. The lithium-ion battery, incorporated into the frame, needs 2,5 hours to fully charge.

Carbon fibre-reinforced polymer is used for the frame and the swinging arm that holds the back wheel, and the same material is used for the 26-inch wheels, which feature an innovative "Audi ultra blade" design with broad flat spokes for optimised transmission of pedal power.

For extreme tricks and stunts, the seat can be lowered to run flush with the frame itself. At the press of a button, the seat rises up, allowing the rider to adopt a comfortable position. Cycling modes and many other functions can be set using the onboard touchscreen computer. The rider's smartphone hooks up by WLAN to the computer, so that when he starts cycling, for example, the immobiliser is deactivated. Video clips recorded via an in-helmet camera are uploaded to the Internet in real time via the smartphone.

And there's more...

VIDEO > Visit *www.popularmechanics.co.za* to watch a video showing how the new AGA iTotal Control cooker is controlled remotely via an iPad.

NOW YOU'RE COOKIN'

Old-world quality meets new-world connectivity

A member of PM's editorial staff has fond memories of gatherings in an aunt's kitchen, warmed by a massive AGA stove on which she would make toast, keep coffee pots hot, and cook sumptuous meals. There was something immensely reassuring about that immovable chunk of cast iron and its gargantuan insulated plates.

Now say hello to its decidedly grown-up ancestor, the AGA iTotal Control cooker. What makes this model special is the fact that its three ovens (roasting, baking and simmering) can be remotely controlled – via your smartphone, PC, laptop, iPad or tablet – no matter where you are in the world, so you can ensure the cooker is warm and supper will be cooked at exactly the time you need it. If you own a phone that isn't especially smart, you can simply send a text message to the AGA to tell it what to do. Here's how it works: the iTotal Control stove has a dedicated SIM card linked to a unique phone number. Once your stove is installed, you save this number into your phone, and when you want to operate it remotely, you send a text message with the appropriate command, and the appliance does the rest.

What? You can't imagine why you'd want to remotely activate your oven from Bulgaria? What are you, a killjoy?

RETRO-MODERN BEAUTY

Striking, elegant, different. What's not to like?

It's known as the Y125 Moegi, and according to its creators, it emphasises the "simple beauty" in the structure of a motorcycle. Interestingly, it's made by Yamaha, a company more often associated with gut-churning power and breakneck speeds. The company is pitching the Moegi both as a daily commuter and an occasional weekend transporter, although one assumes it's aimed at customers who are not in a hurry.

Thanks in part to a slim, lightweight frame and emaciated tyres (think low rolling resistance), the bike emerges with a weight of just 80 kg and a claimed fuel consumption of 80 km/litre in the urban environment. The 125 cm³ engine is coupled to a belt drive for easy maintenance. We rather like it. **PM**

DIY HOME

> BY ROY BERENDSOHN

TIP: For the strongest grain orientation, place the oval grain rings on the new handle so they are on the side, not the top or bottom.

HANDLE WITH CARE

Q I have some old farming tools that have been in my family for years, and I want to restore them. Most need wood handles that I can't find for sale anywhere. Can you help?

A Poles of various thicknesses are available from wood merchants and hardware stores, although most are likely to be made from pine, so you'll need to decide whether your restored tools are for display or hard work (in the case of the latter, pine probably won't cut it). We know of people who've used old Boy Scout staves (you know, those poles they used to carry around on their hikes). However, these have become quite rare nowadays, and short of mugging a Scout (which remains illegal), you'll probably battle to get hold of one.

It's tremendously satisfying to put a tool back in working order, especially one that connects you with your ancestors. The first step in replacing a handle on an agricultural tool is pretty straightforward – you just knock off the head and the ferrule (the metal sleeve on the handle's end) with a hammer. If the head is secured by rivets, grind off their heads and drive out the shanks using a pin punch and a ball-peen hammer. Alternatively, you can drill out a rivet: place a centre punch on the head, whack the punch with a hammer, and drill on the centre mark. If the head doesn't come off and ride up the drill bit, shear off what remains with a sharp cold chisel.

Now you can connect the tool head to the new handle. It's important to get the proper grain direction for handles on spades, forks, hoes and rakes (see the drawing at left). Next, drive the handle into the tang (the long metal tab) at the end of the head. To rivet on a new handle, drill through the handle, guided by the old rivet holes. Insert the rivets, place the socket on a firm surface, such as a heavy wooden block, and dome the rivet head with a ball-peen hammer.

Finally, clean off any rust on the tool head using coarse sandpaper and a wire brush. Sharpen any dull cutting surfaces with a file, then shoot a thin film of spray lubricant on to the toolhead, and you're ready to go to work.

CLEAN CUT

Q When I'm painting, I never can seem to get a clean line in the corners. I've tried masking tape and bought trim brushes. No matter what I do, it never comes out neat. What's the trick?

A You need one of two things to cut a clean line: a steady hand or masking tape. If you use the latter, buy high-quality crepe painter's tape (it's usually coloured blue or green). The beige variety is cheaper and more readily available, but it's all but impossible to get a crisp line with the stuff.

Using a clean, damp cloth, wipe down the surface where you are going to apply the tape. This removes dust that would prevent the tape from bonding; if the tape doesn't bond, paint will get under it and you'll be left with a messy line when you remove the tape.

Apply the tape to the edge, but take

Picture by Seth Smoot

care not to stretch it as you press it into place. Finish by burnishing the tape on to the surface using a metal or plastic putty knife.

Spread the paint and let it dry to the touch before stripping the tape. If you're really concerned about leaving a clean edge, carefully run a utility knife along the paint line to score it before removing the tape. Now gently pull the tape off the surface. If you hear a sharp ripping noise as the tape is coming off the wall, the ceiling or the trim, you're moving too fast. Pull the tape firmly from the surface and angle it back at 45 degrees so it comes away in a shearing action.

The no-tape option is freehand-painting, or "cutting in", a clean line. Buying a high-quality trim brush is a good start – but be sure that it's the right brush. Most cutting in is done with one that's about 5 cm wide (a brush that's much wider or narrower is more difficult to control). Also, the brush should be appropriate for the paint you're applying. A natural- or China-bristle brush works well with alkyd (oil) paint but goes limp in water-based paint, making cutting in a clean line impossible. Water-based paints call for a brush with synthetic bristles made of, say, nylon. Once you've got the right paint-brush pairing and you're ready to cut in the line, dip only the bottom 2 cm of the bristles into the paint. Oversaturation with paint makes even the best brush tough to control.

Professional painters can adeptly pull or push a brush and get a razor-sharp line in a corner. Most of us amateurs, though, will probably have better results if we pull the brush toward ourselves, keeping a small bead of paint rolling along the edge of the brush as we move it along the corner.

FLOORED

Q I spilled some battery acid on my concrete garage floor, and even though I thoroughly rinsed the area with water, the acid still left some large white spots. How can I restore the floor?

A Battery acid is tough stuff, as you've discovered. In this case, it appears to have etched the floor. Given the fact that you've already rinsed the area, you may be able to conceal the blotches by carefully brushing on concrete stain to match the colour of the surrounding surface.

If this doesn't give a satisfactory result, stain the entire floor. To do this, first clean the concrete with a degreaser (your local hardware store will advise you). Next, dampen the floor and sprinkle on the company's etching solution, scrubbing it in with a stiff broom. Finally, rinse the area; when dry, apply a concrete stain. **PM**

Inventors... stand up!

You are cordially INVITED to enter our competition and stand a chance of becoming South Africa's **Inventor of the Year** for 2012. We're now accepting entries for the POPULAR MECHANICS Inventor of the Year competition, our annual showcase of original ideas in two categories: **Emerging Genius** (previously disadvantaged and minimally resourced entrants) and **Cutting Edge** (open to anyone).

Generous prizes are on offer in each category, and the overall winner will be declared South Africa's **Inventor of the Year** for 2012, walking off with a floating trophy plus a large cash award in recognition of his or her achievement.

RULES? There are a few, but we've done our best to make it as easy as possible. For example, your invention must be your own, original work, and it must be fresh (in other words, don't submit something that was featured in your local newspaper 20 years ago). It should also serve a genuine purpose: whereas you might believe a combination nose-hair clipper and tea strainer is exactly what the world needs, you're probably wrong. And finally, keep it real: your rough sketch of a fusion-powered bicycle won't cut it.

WHAT'S YOUR NEXT MOVE?
Start working on your entry right now – but first, *do your homework*. Research it on the Web to make sure your invention isn't replicating someone else's idea (you'd be surprised), gather all the relevant information on your target market, and if possible, build a working prototype (there's nothing quite as reassuring to a judging panel as an invention that clearly works). For entry forms and the "rules of engagement", please visit our Web site at *www.popularmechanics.co.za* or send your entry to *invent2012@ramsaymedia.co.za*

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Popular Mechanics BE THE FIRST TO KNOW | EMERGING GENIUS | CUTTING EDGE

ON THE WEB > From major mission events to how *Curiosity* will be powered on Mars, you'll find it all, and more, on *www.popularmechanics.co.za* (search keyword: CURIOSITY).

It's all about... CURIOSITY

ON 6 AUGUST, NASA'S MARS SCIENCE LABORATORY SPACECRAFT, LAUNCHED AT THE END OF NOVEMBER LAST YEAR, WILL DELIVER A CAR-SIZED ROVER CALLED CURIOSITY TO THE SURFACE OF MARS TO BEGIN A TWO-YEAR PRIME MISSION. ITS JOB – TO INVESTIGATE WHETHER THE SELECTED AREA OF MARS OFFERS ENVIRONMENTAL CONDITIONS FAVOURABLE FOR MICROBIAL LIFE, OR WHETHER THERE'S ANY EVIDENCE THAT LIFE ONCE EXISTED ON THE RED PLANET. FOR THE RECORD, THIS IS A BIG DEAL.

Curiosity. It's a good name for a Mars rover, especially one as large – it's about twice the length and five times the weight of Nasa's twin rovers, *Spirit* and *Opportunity* – and formidably equipped as this machine.

It inherited many design elements from the earlier rovers, including six-wheel drive, a rocker-bogie suspension system, and cameras mounted on a mast to help the mission's team on Earth select exploration targets and driving routes. Unlike its predecessors, however, *Curiosity* carries equipment that will enable it to gather samples of rocks and soil, process and distribute them to onboard test chambers inside analytical instruments.

An instrument named ChemCam will use laser pulses to vaporise thin layers of material from Martian rocks or soil targets up to 9 m away. It will include both a spectrometer to identify the types of atoms excited by the beam, and a telescope to capture detailed images of the area illuminated by the beam. The laser and telescope sit on the rover's mast and share with the Mast Camera the role of informing researchers' choices about which objects in the area make the best targets for further examination. The mission will use radio relays via Mars orbiters as the principal means of communication between *Curiosity* and the Deep Space Network of antennas on Earth.

Electrical power will be supplied by a radioisotope power generator, a canny piece of kit that produces electricity from the heat of plutonium-238's radioactive decay. This long-lived power supply gives the mission an operating lifespan of a full Mars year (687 Earth days) or more. At launch, the generator will provide about 110 watts of power to operate the rover's instruments, robotic arm, wheels, computers and radio. Warm fluids heated by the generator's excess heat are plumbed throughout the rover to keep electronics and other systems at acceptable operating temperatures.

Curiosity's landing site is near the base of a mountain inside Gale Crater, near the Martian equator. In the 23 months following its descent to the Martian surface, *Curiosity* will analyse dozens of samples drilled from rocks or scooped from the ground. This rover can *really* go places: Nasa's Jet Propulsion Laboratory has engineered it to roll over obstacles up to 65 cm high and to travel up to about 200 m a day on Martian terrain.

Nasa announced last month that the rover would touch down even closer to the mountain slope. Said Pete Theisinger, Mars Science Laboratory project manager at Nasa's Jet Propulsion Laboratory: "We're trimming the distance we'll have to drive after landing by almost half. That could get us to the mountain months earlier." PM

Main image: An artist's concept features the *Curiosity* rover as it examines a rock on Mars with a set of tools at the end of the rover's arm, which extends about 2 m. The mast supports two remote-sensing science instruments – the Mast Camera for stereo colour viewing of surrounding terrain and material collected by the arm; and the Chemistry and Camera instrument, which uses a laser to vaporise a speck of material on rocks up to 7 m away.

Pictures: Main and top left: NASA/JPL-Caltech / Bottom right: United Launch Alliance

This artist's concept depicts the rover *Curiosity* as it uses its Chemistry and Camera (ChemCam) instrument to investigate the composition of a rock surface.

An artist's concept of the rover and descent stage for Nasa's Mars Science Laboratory spacecraft during the final minute before the rover touches down on the surface of Mars. The descent stage will provide rocket-powered deceleration for a phase of the arrival at Mars after the phases using the heat shield and parachute. As it nears the surface, shortly after the moment depicted here, the descent stage will lower the rover on a bridle and deliver it to the ground.

Nasa's Mars Science Laboratory spacecraft, sealed inside its payload fairing atop the United Launch Alliance Atlas V rocket, clears the tower at Space Launch Complex 41 on Cape Canaveral Air Force Station in Florida.

FIX IT IN POST

Five software strategies that turn home videos into home movies.

> BY ANTHONY VERDUCCI

The past 30 years of video technology have democratised movie-making – maybe too much. Anyone can now shoot high-definition video on a smartphone and instantly upload it to YouTube for the entire world to see. That type of uncut cinema verité style makes for good cat-playing-piano clips (if there is such a thing), but the videos that are truly important to you deserve more polish.

The best way to get great results in the editing bay is to shoot quality footage in the first place, with a strong sense of the tale you want your video to tell. But it's amazing how a little bit of work in a basic video-editing program can turn some less than perfect clips into a dramatic exercise in visual storytelling.

Resist the impulse towards special effects and other visual tricks – if you don't know how to organise, arrange and splice your clips into a harmonious narrative, then all that stuff is just decoration on an unbaked cake. Following these simple guidelines will do a lot more for your video.

1 UNRAVEL THE STORY

Most consumer-grade video-editing programs are non-linear, which means they allow you to grab and manipulate your clips without destroying the original material. Software such as Windows Live Movie Maker and Apple's iMovie, and shareware such as AVS Video Editor, use a storyboard that lets you lay out your clips and rearrange them however you like. Most professional moviemakers would start with a script, then storyboard before they shoot anything. But for clips you've already taken, you're going to have to do that process in reverse.

Take the clips you want to use and drag them to the board, then rearrange them until you see a story emerge. Don't worry about clips blending together at this point; just look for a rough sense of narrative progress. Consider the mood and pacing of the footage. Is it sports video with lots of movement and action? Are there lots of close-ups and dialogue? Has your subject been shot from multiple angles? The longer you want your movie to be, the more variety you should be looking for. If it seems as if something's missing, make notes about additional footage, or B-roll, you can film to fill in the blanks (iMovie has dummy clips called Animatics that you can use as placeholders).

2 TRIM THE FAT

It's good to overshoot when it comes to video. But the more footage you have, the more ruthlessly you have to cut in post-production. The process of editing is all about being selective and stitching together your best material in a way that tells a story efficiently. In each clip, look for the crux of the action and drop anything that's not pivotal. (Most programs let you trim with a simple select and delete.)

As a general rule, try keeping clips under 10 seconds – short shots will give your movie a lot more energy than longer ones. That said, don't cut your clips so short that they become confusing.

3 CLEAN IT UP

It's best to plan your lighting, composition and camera technique before you shoot, but in case that didn't happen, there's still plenty you can do with software. The capabilities vary from program to program. Windows Live Movie Maker is the least sophisticated, but if you're willing to tinker with third-party filters, you can use the free, linear VirtualDub program to do some basic corrections, then import the clips into WLMM for editing.

More sophisticated video suites such as iMovie and AVS offer cropping, colour correction and stabilisation, which can compensate for sloppy camerawork. Tinkering with the image can have a downside, however – digital cropping and stabilisation can lower resolution. But used judiciously, these tools can help smooth out variation from clip to clip, or turn a bland shot of someone talking into a dramatic close-up.

4 BLEND IT TOGETHER

Frequent cuts and angle shifts make a movie more dynamic, but done wrong, these techniques can be jarring. Knowing how to gracefully move from one shot to another is an art form. Most video editors offer lots of fancy sweeps, mosaic dissolves and other spinning, flipping novelty transitions, but if you trust your material, keep it simple. Transitions are usually found under a menu or palette (some software labels them as *effects*). Don't use too many kinds of transitions – rather stick to quick cuts for back-and-forth dialogue, cross-fades for blending clips together, and fades to either black or white for complete scene changes.

5 SMOOTH OUT THE SOUNDTRACK

Unfortunately, the built-in mics on camcorders and smartphones are uniformly awful for recording dialogue. If you were unfortunate enough to capture Bigfoot's first recorded growl in a windy patch of forest, both AVS and iMovie offer tools to remove background noise. But remember, software can't perform miracles, and while it's advisable to tinker with the audio settings to get the best results, too much noodling will cause muffled distortion.

Keep in mind that your audio doesn't always have to be tied to your video. If you've got footage of your daughter telling a hilarious story about the family dog chasing its tail, but it's just a still shot of her talking, split the audio track from the video and splice in a shot of the dog spinning around while she tells the story, then cut back to her giggling hysterically at the end – it makes for a far more interesting effect.

Finally, if your recorded audio is garbage or just irrelevant to the action, drop in some music for a mood-setting soundtrack. Editing together wistful memories of your kid growing up? Dial up the sentiment with some Jack Johnson. Trying to make your hockey team's highlights even more awesome? Lay down a track of AC/DC and match the visual cuts to the rhythm changes. But don't invite the wrath of music industry lawyers – if you're posting to the Web, search for royalty-free music on Web sites such as *freeplaymusic.com*.

ADVICE FROM AN EXPERT

JOEL NEGRON, film editor on *Sleepy Hollow, Transformers: Dark of the Moon* and *21 Jump Street*

... on getting organised

"Go through your video and make a select reel. It doesn't have to make sense, just get your best footage for each section of the story. Some people make multiple select reels for close-ups, wide shots, medium shots, or all shots of each actor."

... on adding drama

"When editing, I use music from other movies. You can have a shot of a guy just sitting on a bench, and there's nothing happening, but if the music is telling you to feel sad, then you're going to feel sad, and if the music communicates tension, then you're going to feel tension."

... on filling in the blanks

"If you're editing footage of, say, a football game, and the cameraman filmed a touchdown pass, but missed the ball in the air, then the easiest thing to do is cut to a shot of the crowd, then cut back to the guy running the ball." **PM**

PopularMechanics.co.za

PM DIGITAL GETS A NEW FACE

Visit the all-new PM Web site (still at ***www.popularmechanics.co.za***), now accommodated on the cutting-edge Wordpress content management system. Content-rich, visually attractive and visitor-friendly, with intuitive navigation and many levels waiting to be explored... these are just a few of the compelling features that spring to mind. We hope you agree!

Our weekly Web letter, ***The Cutting Edge***, has also undergone a radical transformation to create a cleaner, easily navigable channel that allows us to communicate with you more effectively.

We've been working long hours to ensure a successful migration to the new platform, but of course, minor teething problems are inevitable. If you stumble upon anything that doesn't look right or simply doesn't work, please e-mail ***kated@ramsaymedia.co.za***

VOTE FOR YOUR BEST 2011 PM COVER – AND WIN!

Vote for your favourite 2011 Popular Mechanics cover on PM's Facebook Page at *www.facebook.com/PopularMechanicsSA* – you could **WIN** a **Casio G-shock watch** worth **R1 499**.

TRIUMPHANT LANDING OF SOLAR IMPULSE in Ouarzazate, Morocco

After a first failure to reach Ouarzazate, Solar Impulse – the first aircraft designed to fly day and night without requiring fuel and without producing carbon emissions – successfully completed its flight to Morocco's southern region of Ouarzazate on 22 June. This was Solar Impulse's most difficult destination yet due to the hot and arid desert climate marked by turbulence and high winds. Visit ***www.popularmechanics.co.za*** to watch highlights of the take-off and landing.

YOUR TWEETS

@khaliqd Thanks to @popmechsa I was able to unclog my blogged toilet using a 2ltr coke bottle. Still a sh#$$% job though...

@KashmiriBeesham I'm now subscribed to @popmechsa via Discovery Vitality. My first mag should arrive within a few weeks :) #Excited

@twidanny @2infinity1 is jealous! RT @popmechsa: PM's deputy editor, Anthony Doman, is in Italy for the launch of Volvo's... m.tmi.me/rZq4g

@CptJBDiederichs June issue of Popular Mechanics looks legen... Wait for it... DARY!! LEGENDARY!! Good job @popmechsa

@_ChanSolo WOOOHOO! I Won 2 tickets to the premier of Prometheus! Cool birthday present! Thanks to @popmechsa you guys rock.

COMPETITIONS

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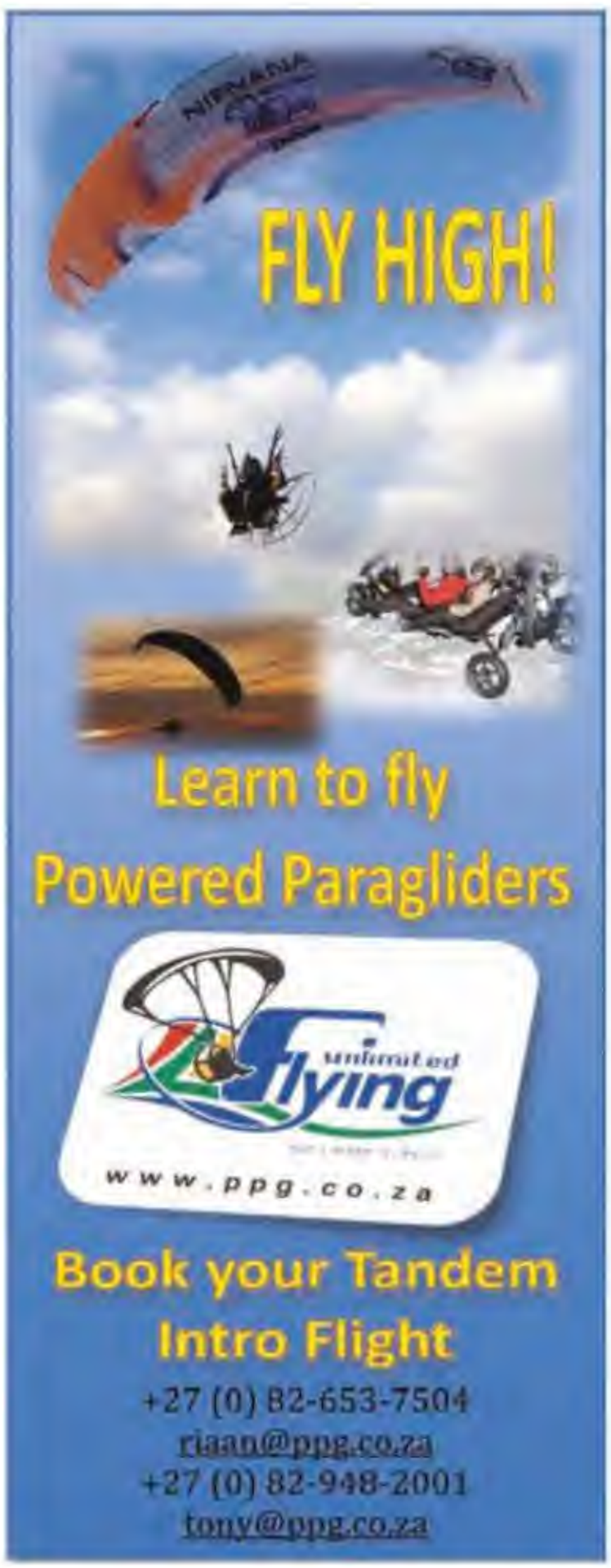

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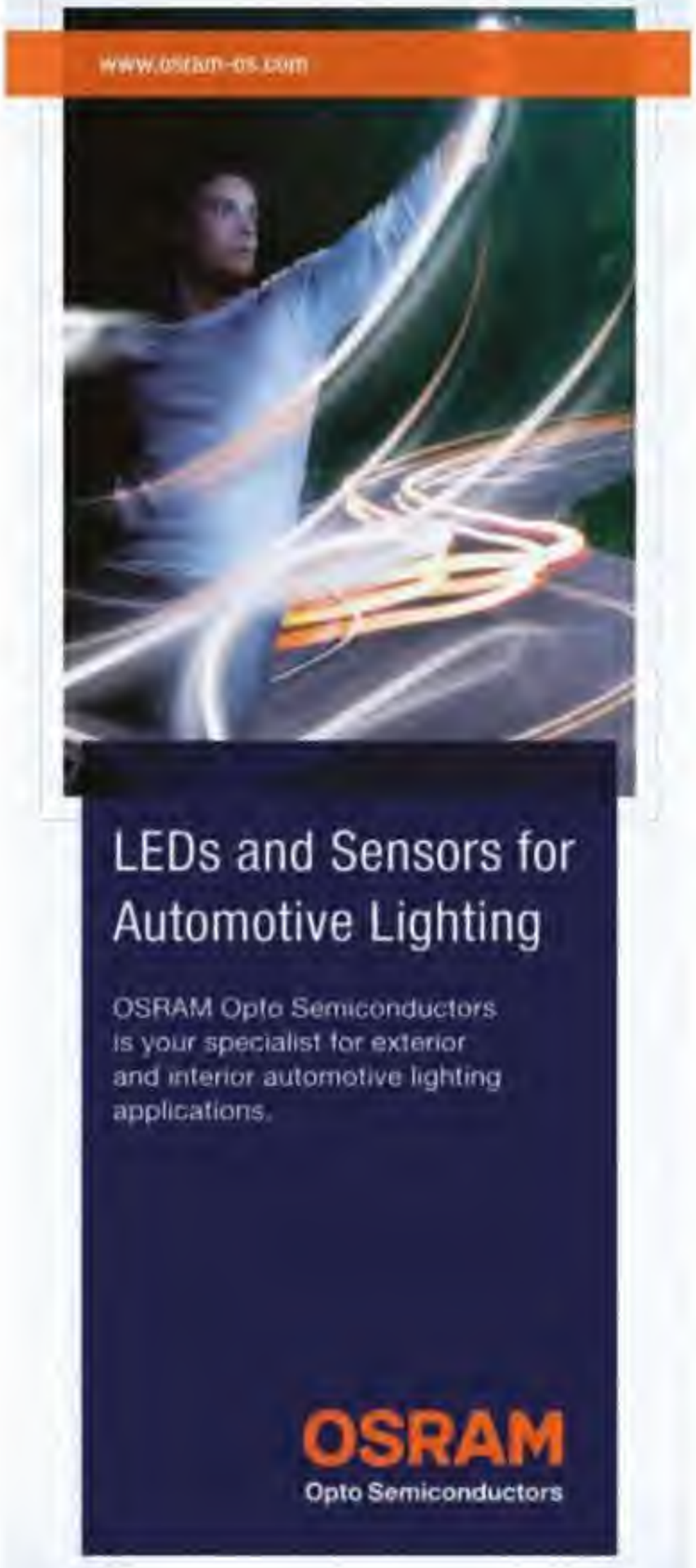

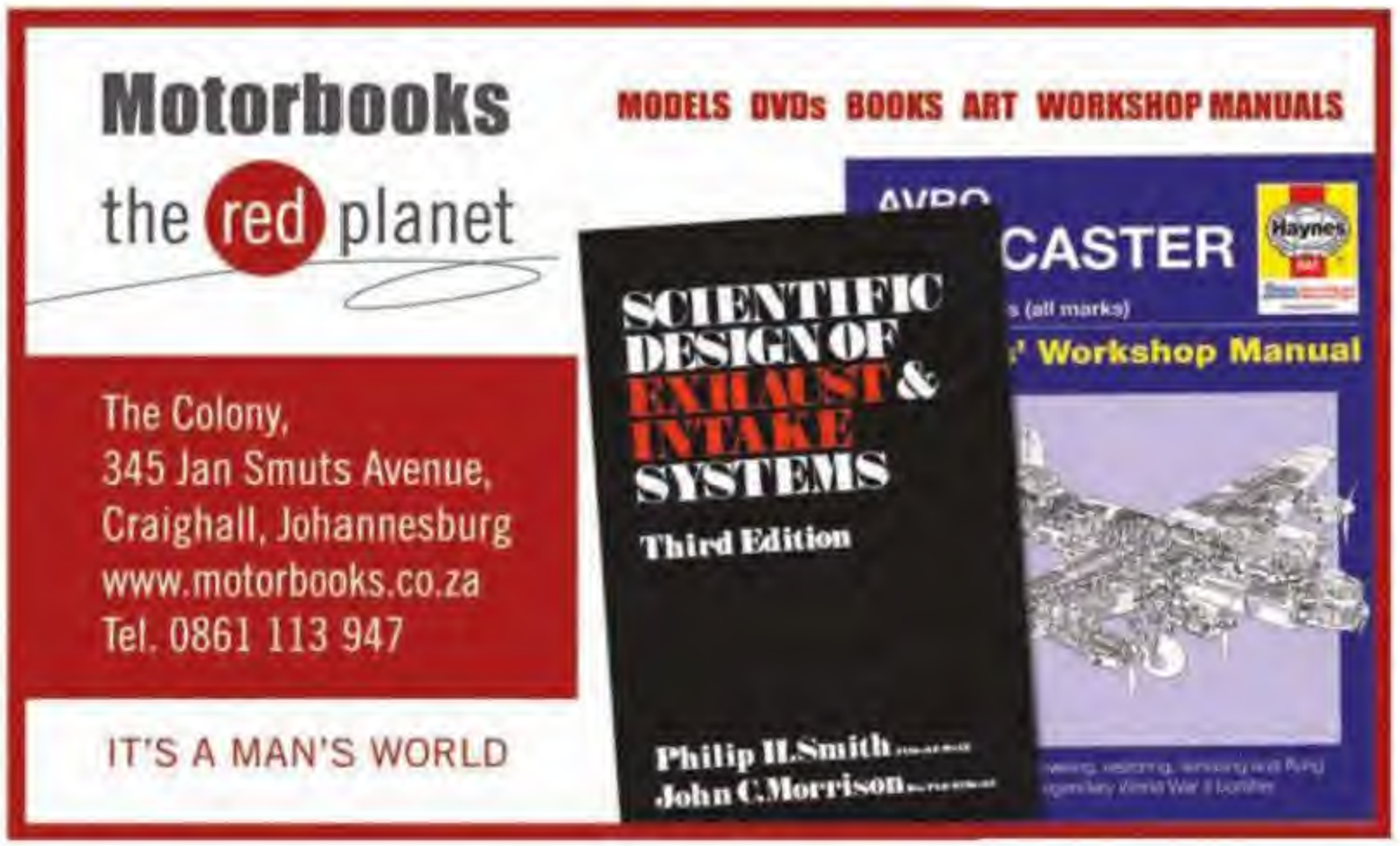

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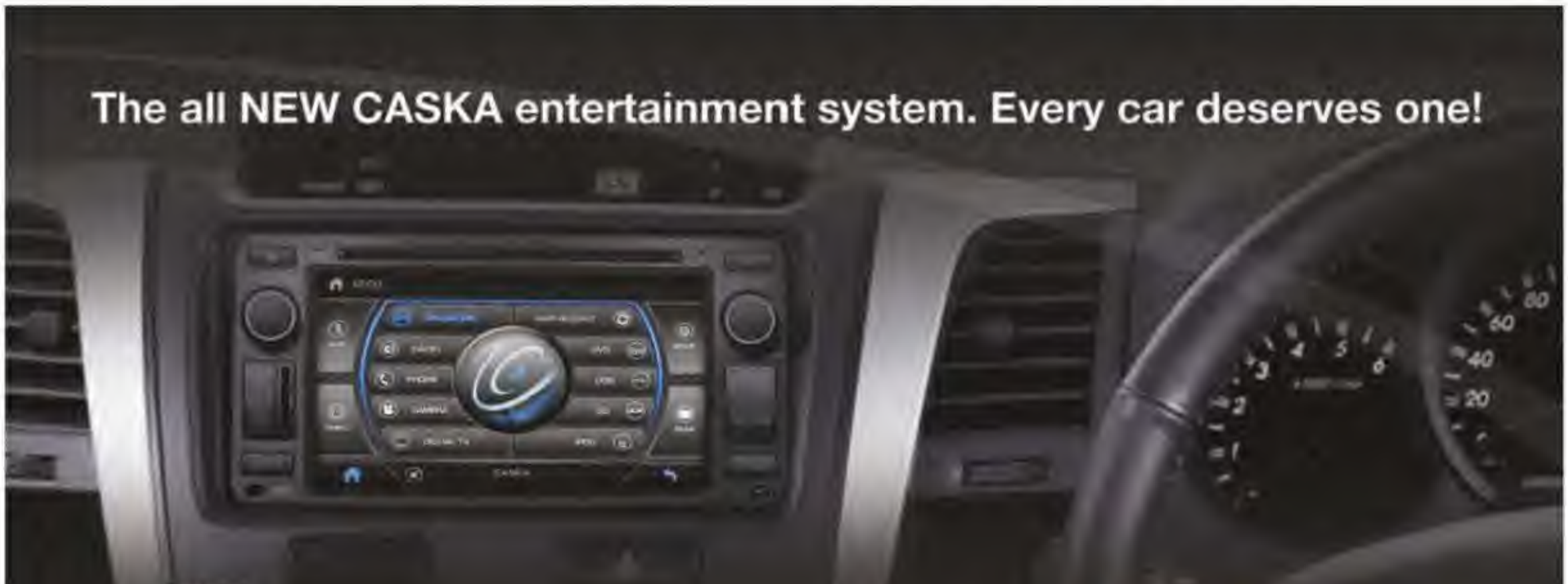

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When we lived in Randburg, our house became quite cold in winter, so I installed wall-mounted panel heaters in the bedrooms. One day, after moving a small couch in one of the rooms, I noticed that the wall behind it was warm to the touch. It turned out the heat was being transmitted through the wall by the panel heater in the adjoining room – which seemed rather a waste. So, when I next installed panel heaters, I decided to add a heat shield: I did this by cutting out the shape of the panel heater from the box it came in and covering it in ordinary aluminium foil, fixing it to the wall behind the heater with the same screws as the panel itself.

It works well. The walls remain cool and the heat is used more effectively by exploiting the convection currents between panel and wall. I contacted the manufacturers and suggested they modify their packaging to create something similar, but they weren't interested. I also save electricity by using time switches.

GERT CLOETE
HERMANUS

Of dull parquet and hard places

Many old houses have parquet floors that are regarded with disdain, partly because the cost of having them professionally sanded and varnished is no more appealing than their replacement with tiles or synthetic wood. This leaves many owners of old homes stuck between a rock and a hard place.

What *really* makes parquet floors dull and difficult to maintain is the build-up of polish over the years. Whereas a good polishing may provide a day's worth of shine, the floor soon returns to its dull state. Here's my simple solution: clean it with turpentine. Pour a small amount directly on to a dry mop and wipe the floor. With each sweep, the turpentine will remove the accumulated polish, nourishing the wood at the same time.

KELLY RICHARDS
BELLVILLE

Hide from the spiders

If you're a regular Internet user, you should know about those digital nuisances called "spiders" – simple programs that crawl through the Web and collect e-mail addresses by searching for lines containing the "@" symbol; the addresses are then sold to spammers (and we *really* love them, don't we?). To protect my own, very simple site from these pests, I provide my e-mail address in the form of a gif image that can be read by real people but not by programs with a dodgy agenda.

LOU STEPHENS
DURBAN

Beware the dreaded wobble

I find that when using thin drill bits of the order of 2 mm in a drill press, the bit tends to bend and wobble when pressure is applied, resulting in a hole that's off-centre. This problem is exacerbated in some woods where the drill follows the grain, resulting in the hole drifting from the perpendicular, sometime breaking the bit. To resolve the problem, I seat the drill bit as far into the chuck as it will go, leaving just a few millimetres exposed; this keeps the bit vertical and prevents the wobble effect. As the hole deepens, I extend the drill bit from the chuck, using the hole as a guide to keep it vertical.

RAYMOND BYNG
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